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THE GENEALOGY OF MAN.

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The ancestry of man is a question to be solved by paleontology. Within the last twenty years, important progress has been made in our knowledge of the phylogeny of the mammalia, and some points have been gained which throw considerable light on the more immediate predecessors of man. These additions to knowledge have been made in the fields of both simian and human paleontology, and they have naturally received attention from archeologists as well as paleontologists. The question must be approached from the side of anatomy primarily, although aid from any other source is essential. Philology can, of course, give us no assistance, since the first man can have left no trace of his language. It is a fact that in some quarters, archeologists who are not anatomists, seem to underrate the value of anatomy in the premises, and are inclined to dispute the existence of men of very primitive or simian physical characteristics. But archeology, apart from anatomy, is a poor guide in the field of human ancestry.

Nothing is better known than that some races of men present a larger proportion of simian characteristics than others. Thus these approximations are fewest in the Indo-European race, and are rather more evident in the Mongolian. In the Polynesian, Negro, and Bushmen, they are most numerous, and in about equal but differently distributed proportions. Confining

our attention to the skeleton, it is known that almost every part of it is the seat of variations of greater or less significance.

Much importance attaches to the dentition. Many years ago, Owen[1] called attention to the fact that in the dark races the roots of the last superior molar are distinct from each other, while in the Indo-Europeans they are known to be more or less fused together. These now well-known characteristics of human dentition constitute one of the examples of transition from a simian to a human type. I have pointed out a corresponding modification in the structure of the crown of the superior true molars, viz: the transition from a quadritubercular to a tritubercular structure in passing from the lower to the higher races. As this point has some interesting implications in the earlier phylogeny of man, and as its value has been disputed, I give it a little attention.

The facts of the case are as follows: I have demonstrated[2] the fact that all forms of dentition exhibited by the Eutherian Mammals have been derived from a primitive tritubercular type. Professor Osborn says that he expects to be able to do the same for the Multituberculate (? Prototherian) dentition. I have also shown that man exhibits a tendency to revert from his primitive quadritubercular molar to this tritubercular type.[3] These facts are now common knowledge among paleontologists, although Dr. Brinton states in one of his late works that the latter proposition has been "refuted" by Dr. Harrison Allen and Professor Virchow. As to the significance of these facts, I have expressed the view that this acquisition of a tritubercular molar is a reversion to the lemurine type. This conclusion is necessary because the lemurs are the last of the families in the line of the ancestry of man which present this dentition. The monkeys and anthropoid apes are all quadritubercular, except a few limited collateral branches of the former, which still retain the lemurine type. There are also a few collateral types of lemurs which have acquired one

[1] Odontography, 1840–5, p. 454.

[2] Proceeds. Amer. Philosoph. Soc., Dec. 1883; Origin of the Fittest, 1887, pp. 245, 347, 359.

[3] Amer. Journal of Morphology, II, 1888, p. 7.

or more quadritubercular molars, but they are not typical. In many tritubercular mammals, a precocious form or two can be found, which has acquired the fourth tubercle. But the further back we go in time, the fewer they become, until, in the Puerco fauna, of eighty-two species of Eutherian Mammals, but four have true quadritubercular superior molars.

I take this opportunity of saying, however, that reversion is not necessarily a result of heredity. It may be simply a retrogression on a line of advance already laid down. What influence lemurine heredity may have had in the case of man, it is not easy to know. But it must be borne in mind that various forms of degeneracy of molar teeth are possible other than the resumption of the tritubercular type, yet the normal reduction generally presented, is just this lemurine and primitive Eutherian condition. The simplicity of the elements involved, has something, but not everything, to do with this reversion.

Dr. Paul Topinard has made an investigation[4] of the characters of the crowns of the molars in man, and has reached general conclusions identical with my own. He remarks (p. 665), "It is demonstrated, in conclusion, that the teeth of man are, at present, in process of transformation, and that in some future which is remote, the inferior molars shall certainly be quadricuspid, and the superior molars tricuspid. It will be curious to have the statistics as to prehistoric man; unfortunately, their crania are rare, and their molars generally much worn." In the details of his examination, there are some divergencies from my results. Thus he finds the quadritubercular second and third superior molar relatively of more frequent occurrence in Europeans than I did. But the absence of Europeo-Americans from his tables reduces the percentage of trituberculars in the Indo-Europeans. He makes no report of Esquimaux. Had he observed this type, he would have found a higher per cent. of tritubercular upper molars than in any race that he has recorded. He confirms my conclusion as to the high percentage of quadritubercular superior molars in the Malays, Polynesians and Melanesians.

[4] L'Anthropologie, 1892, p. 641 (Nov., Dec.).

The relation of this fact to phylogeny is to confirm Hæckel's hypothesis of the lemurine ancestry of man. I have advanced the further hypothesis that the Anthropomorpha (which include man and the anthropoid apes) have been derived directly from the lemurs, without passing through the monkeys proper. This close association of man with the apes, is based on various considerations. One of them is that the skeleton of the anthropoid apes more nearly resembles that of man in the most important respects than it does that of the monkeys. This is especially true of the vertebral column, where the anapophyses are wanting in the Anthropomorpha (insignificant rudiments remaining on one or two vertebræ, as pointed out by Mivart), while they are well developed in the monkeys and lemurs. The frequent presence of the tritubercular molar in man disposes of the superior claim of the monkeys over the lemurs to the position of ancestor. Another significant fact pointing in the same direction is the existence of large-brained lemurs with a very anthropoid dentition (Anaptomorphidae) in our Eocene beds. This resemblance is very remarkable, much exceeding that lately observed by Ameghino in certain extinct forms of monkeys in Patagonia, which appear to be ancestors of the existing South American monkeys (Cebidae), and possibly of the Old World monkeys also. The superior molars of Anaptomorphus are tritubercular, while the premolars, canines, and incisors are essentially anthropomorphous, and rather human than simian. Anaptomorphus is probably at the same time the ancestor of the Malaysian lemurine genus Tarsius, and M. Topinard remarks that Tarsius has as good claims to be regarded as ancestral to Homo as Anaptomorphus. But M. Topinard must be aware that in the existing genus the character of the canine and incisive dentition is very unlike that of the Anaptomorphus and Homo. It is specialized in a different direction. The dentition of Anaptomorphus being so generalized as compared with Tarsius, I suspect that its skeleton will be found to present corresponding characters. Of course, if it be found hereafter to have the foot structure of Tarsius (which I do not

anticipate), it must be removed from the line of ancestry of the Anthropomorpha.

It must be further observed that the ancestral line of the Anthropomorpha cannot be traced through any existing type of Lemuridae, but through the extinct forms of the Eocene period.[5] This is on account of the peculiar specialization of the inferior canines, which are incisor-like, and because of the peculiar character of the incisors themselves, in the modern lemurs in the restricted sense. But we have numerous lemurine types of the Eocene of both America and Europe which satisfy the conditions exactly, so far as the dentition is concerned. These are mostly referable to the family Adapidae.

Unfortunately, we do not know the entire skeletons of these Eocene lemurs, but as far as we have them (genera Tomitherium and Adapis), they are monkey-like. But we have what is almost as useful, the skeleton of their Eocene and Puerco ancestors, the Condylarthra. I long since pointed out that the latter order (not the genus Phenacodus, as Lydekker has represented me as saying), must be the ancestors of the lemurs, basing my views expressly on the general structure of Phenacodus, Periptychus and Meniscotherium. The structure of the ungual phalanges of Periptychus is very significant, and even more so is that in Meniscotherium, as recently shown by Marsh, who adopts (without credit) my hypothesis of lemurine affinities of the Condylarthra (which he renames the Mesodactyla). From Condylarthra back to Creodonta is an easy transition, and I have always assumed that the Creodonta were derived from generalized Polyprotodont Marsupialia. This view has been entirely confirmed by the recent discoveries of Ameghino in Patagonia, where he has found forms whose remains may be referred with equal propriety to the one group or the other. M. Topinard has been rather hasty in reaching the marsupial ancestry in supposing that Phenacodus belongs to that order. All the evidence shows that Phenacodus is a generalized ungulate placental.

To return to the more immediate ancestry of man. M. Topinard believes that I hold the opinion that the Hominidae

[5] On the Primitive Types of the Orders of the Mammalia Educabilia, 1873, p. 8.

descended directly from the lemurs without the intervention of the Simiidae. I have, on the contrary, expressed[6], and now maintain as a working hypothesis, that the Anthropomorpha were descended from the Eocene Lemuroids. In my system[7] the Anthropomorpha includes the two families Hominidae and Simiidae. The sole difference between these families is seen in the structure of the posterior foot; the Simiidae having the hallux opposable, while in the Hominidae the hallux is not opposable. This is not a strong character, since it depends on a slight difference in the form of the entocuneiform bone. In some vertebrates, as the tree frogs, the same and similar characters (genus Phyllomedusa) are not regarded as of family value. It is then highly probable that Homo is descended from some form of the Anthropomorpha now extinct, and probably unknown at present, although we do not yet know all the characters of some extinct supposed Simiidae, of which fragments only remain to us. It cannot now be determined whether man and the Simiidae were both descended from a genus with opposable hallux, or without opposable hallux, or whether from a genus presenting an intermediate character in this respect. This genus was, in any case, distinct from either of the two existing genera of Simiidae, Simia and Hylobates, since these present varied combinations of anthropoid resemblances and differences, of generic and specific value.

Professor Virchow has recently[8] thrown down the guage to the evolutionary anthropologists by asserting that "scientific anthropology begins with living races," adding "that the first step in the construction of the doctrine of transformism will be the explanation of the way the human races have been formed," etc. These two assertions are inconsistent, since the only way of solving the latter problem will be by the discovery of the ancestral races, which are extinct. The ad captandum remarks of the learned professor as to deriving an Aryan from

[6] American Naturalist, 1885, p. 467.

[7] Origin of the Fittest, 1887, p. 346, from American Naturalist, 1885, p. 346, where the classification of the Taxeopoda should be in a foot-note; loc. cit., 1889, October.

[8] Popular Science Monthly, Jan. 1893, p. 373, translated.

a Negro, etc., remind one of the criticisms directed at the doctrine of evolution when it was first presented to the public, as to a horse never producing a cow, etc. It is well known to Professor Virchow that human races present greater or less approximations to the simian type in various respects. Such are the flat coössified nasal bones of the Bushmen; the quadritubercular molars of the Polynesians; the flat ilia and prognathous jaws of the Negro; the flat shin-bones of various races; the divergent hallux of some aborigines of farther India, etc. But that no nearer approximation to the simian type than these has been discovered in any race will surprise most students of the subject. Professor Virchow does not satisfactorily explain the significance of the Cannstadt and Neanderthal skulls, and in his address he ignores the important and well authenticated discovery of the man and woman of Spy. To these ancient people I will now devote some space, describing more especially the dentition, so far as it has been preserved.

What had been long suspected is now established, through the discovery and descriptions of MM. Lohest and Fraipont of

FIG. 1—SKULL OF THE MAN OF SPY. From Professor G. F. Wright's Man and the Glacial Period. From a photograph.

Liége, viz.: that there dwelt in Europe during paleolithic times, a race of men which possessed a greater number of simioid characteristics than any which has been discovered elsewhere. The important discovery in the grotto of Spy, of two skeletons, almost complete, served to unify knowledge of this race, which had previously rested on isolated fragments only. These skeletons proved what had been previously only surmised, that the skeleton of Neanderthal, the lower jaw of Naulette, and the crania of Cannstadt, belong to one and the same race. The simian characters of these parts of the skeleton are well known. These are the enormous superciliary ridges and glabella; the retreating frontal region; the thickness of the cranial wall; the massive mandibular ramus with rudimentary chin, and the large size of the posterior molars. MM. Fraipont and Lohest have added other very important characters to these, viz: the tibia shorter than in any other known human race; the sigmoid flexure of the femur; the divergent curvature of the bones of the fore-arm, and a very peculiar form of the posterior face of the mandibular symphysis. Of these characters MM.

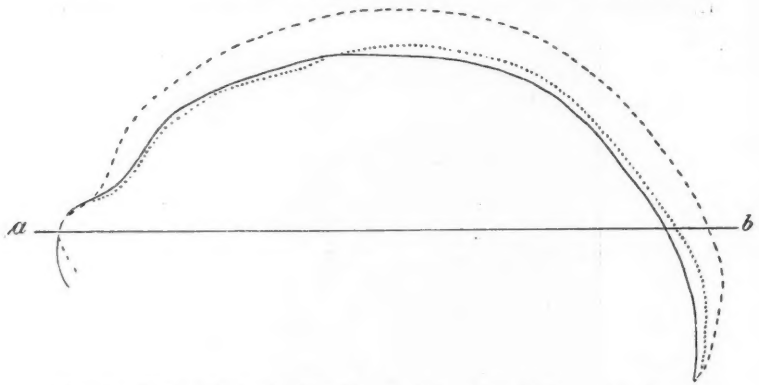


FIG. 2.—Outlines of calvaria of the Neanderthal man in solid line; of the Spy man no. 1 in dots; and of the Spy man No. 2 in broken line. From Fraipont and Lohest.

Fraipont and Lohest write as follows:[9]

I.—The prominent superciliary crests, which are characteristic of the Cannstadt race. No existing race presents such a

[9] Archives Belges de Biologie, VII, 1886, p. 731, Gand.

development, neither the Papuans, Australians, nor Negroes of any race. But we find the superciliary crests and underlying sinuses identical in adult female orangs and chimpanzees and young male gorillas. In the female chimpanzees the crests are almost inferior in size to those of the man of Spy.

II.—The retreating forehead of the two crania of Spy, is not found in any existing human race, while it is typical of that of Cannstadt. It is characteristic of female orangs and gorillas and of the young males of both species, and of adult males and female chimpanzees. It appears in existing men in rare and isolated cases.

III.—The prominent transverse superior semicircular crest of the occipital bone is found in existing races among the Fellahs of Africa and the Nigritos. It is characteristic of the Cannstadt skulls, and presents exactly the same characters as the young male and female orang and gorilla, and young male and adult female of the chimpanzee.

IV.—No human race presents the characters of the lower jaw exhibited by those of Spy, Naulette and Shipka. In this part of their osteology the anthropoids depart widely from man, the most conspicuous point in the latter being the presence of a chin. Accordingly, the angle formed by the anterior face of

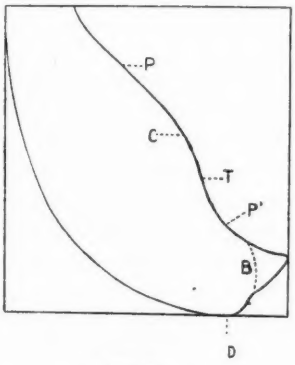


FIG. 3.

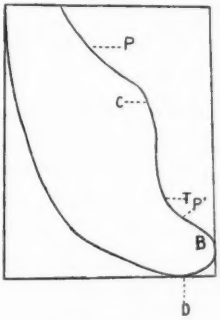


FIG. 4.

Vertical sections of symphysis mandibuli of gorilla (Fig. 3), and orang (Fig. 4). From Fraipont and Lohest.

the symphysis with the inferior border of the horizontal ramus, is less than a right angle in man, and much more than a right angle in the anthropoids. According to Topinard, this angle in fifteen Parisians is 71°.4; in fifteen African Negroes, 82°.2; in fifteen Neocaledonians, 83°.9; in the jaw of Naulette, 94°. In the best preserved jaw of Spy, the angle is 107°, if measured from the inferior symphysial border, or 90° if measured from the inferior border of the ramus. There is no chin in the jaw of the Cannstadt race, and the large angle approaches without nearly equaling that of the anthropoids. But the posterior face of the symphysis presents the most remarkable peculiarity. In the symphysis of the apes (Figs. 3, 4, 5) the posterior border is a continuous slope from the alveolar border to the inferior

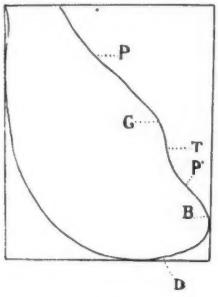


FIG. 5.

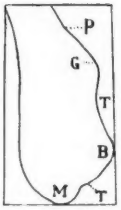


FIG. 6.

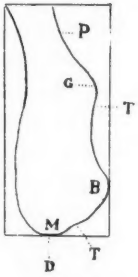


FIG. 7.

Vertical sections of symphysis mandibuli of chimpanzee (Fig. 5); of Spy man No. 1 (Fig. 6), and Spy man No. 2. (Fig. 7). From Fraipont and Lohest.

margin, interrupted by a slight concavity below the middle. In the human jaw this line slopes backward to near the middle, where are situated the small tuberosities for the insertion of the genio-glossal muscles. (B in the accompanying figures.) The surface then slopes rapidly forward to pass into the narrow inferior border of the chin (Figs. 8, 9). In the jaws Naulette and Spy, the structure is exactly intermediate between the two, and quite different from both. It commences above with a posterior slope similar to that of the apes, exhibiting what is called by Topinard, internal prognathism, as it appears in the lower human races. The surface then descends abruptly, form-

ing a vertical concavity, which is bounded a considerable distance below by another protuberance, the insertion of the genio-glossal muscles. This concavity is not present in the human symphysis, while it is less developed in the simian. The surface then slopes forward, as in the human symphysis, but this portion is shorter than in human jaws generally. It is represented by a convex face in the simian jaw. This character taken in connection with the others cited, goes a long way toward justifying the separation of the Cannstadt race as a distant species, as has been done by some author under the name of *Homo neanderthalensis* (Figs. 6, 7).

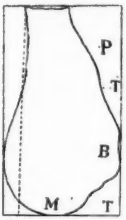


FIG. 8.

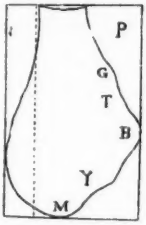


FIG. 9.

Sections of symphysis mandibuli of modern Liegois (Fig. 8), and of an ancient Parisian (Fig. 9). From Fraipont and Lohest.

V.—The curvature of the ulna and radius, which produces a wide interosseous space, is not found in any human race, but is common to the apes. On the contrary, the shortness of these bones is entirely human.

VI.—The anterior convexity of the femur, with its round section, is only found among living races among the Nigritos of the Philippine Islands. It is seen in a less degree in femora of neolithic men, and occasional instances are seen among existing Europeans. It is the normal condition in the apes.

VII.—The tibia is shorter in its relation to the femur than in any human race, and is more robust than in most of them. This character, with the oval section, while not identical with what is seen in the apes, forms an approximation to it.

VIII.—The condyles of the femur are not only wider than in human races generally, but they are more produced posteriorly. The portion habitually resting on the head of the tibia

is so far posterior as to throw the femur backward when in place. This requires that in order to maintain equilibrium, the head and body must have been thrown forward. This relation of the femur and tibia is what we find in the apes, and it is highly probable that the man of Spy presented a somewhat similar figure when walking. That is, the knees were bent and the body thrown forward. In the best preserved leg, the knee was also slightly bent inward. The femur had, however, the superior length generally characteristic of man, though this, it is well known, is a variable character.

MM. Fraipont and Lohest have pointed out the general characters of the dentition of the man of Spy. They show that the molars increase in size posteriorly to the same extent that they do in the apes, which is the reverse of what is usual in man, where they diminish posteriorly, or, in a few lower races (Australians, etc.), remain equal. They show that the superior molars are all quadritubercular, and that the internal root is distinct in all of them. Through the kindness of M. Lohest, I received casts and photographs of these teeth, and I give here figures the former (Plate IX), which are more satisfactory than those in the memoir from which I have already quoted so fully, where, indeed, the grinding faces are not represented at all. I also make some remarks which they suggest, on some details not noticed by MM. Fraipont and Lohest.

The casts of the teeth of the man are those of P. m. ^{2} and M. $^{1\,2}$ of one side, and of M. $^{1\,2\,3}$ of the other side. Those of the woman are alveoli of I. ^{2} and C. ^{1}, and the entire teeth of P. m. $^{1\,2}$ and M. $^{1\,2\,3}$ all of one, the right, side. The crowns of the man's teeth are moderately worn, so that their composition can be studied, while those of the woman are more worn, so that the composition is somewhat obscure. Comprehensively, it may be stated that the true molars are fully quadritubercular, as in the lowest known races of men, and that the hypocone is in the anterior molars, as large as the protocone, while it is always smaller in man when present. In the female the last superior molar has a well-developed internal root, which diverges widely from the posterior external, even more widely than in a chimpanzee in my possession. This arrangement is

even more simian than that seen in Australian and Maori dentitions in my collection. The last molar of the male is stated to have similar structure, but the roots cannot be clearly seen in the plaster cast. These two characters then place the man of Spy in the lowest category, just as would be naturally expected in the presence of the other simian characters already referred to. The dentition is inferior to that of the neolithic man of France,[10] where the last molar at least is tritubercular.

Some other peculiarities of these dental series may be now referred to. In the female dentition, where alone the canine alveoli remain, the size of the latter tooth and that of the premolar is large, relatively, to that of the true molars. The canine is not remarkably large, but exceeded by a little, that commonly seen in Polynesians and Australians, where it is largest among human races. The premolars exceed a little the proportions seen in the same races, approximating but not quite equaling the relative dimensions seen in the chimpanzee. The roots are relatively more robust in the transverse direction than in human dentitions generally. The first and second molars of the female are of equal transverse diameters, while the third is a little wider transversely and quite as wide anteroposteriorly. This large dimension for the third molar exceeds anything I have observed in human dentitions except in the case of a single Australian in my collection, surpassing a little that of the chimpanzee, and reminding one of some of the gibbons (Hylobates), where, however, the crown is subcircular in outline. In the male the transverse diameter of the third molar is a little smaller than that of the other molars, but the tooth is larger than is usual in man, and equals in its dimensions that of the chimpanzee.

A peculiarity which is pronounced in the male, and observable in the first molar only of the female, is the prolonged posterior convexity of the grinding surface. This is unlike anything I have seen in human molars, and resembles the character of the orang[11] more than that of any other quadrumane known to me. This appearance is increased by a contrac-

[10] Cope loc. cit., p. 17.

[11] Owen Odontography, p. 444.

tion of the grinding surface posteriorly, by the convergence of the internal and external borders, a peculiarity apparently unique to the man of Spy. The forward overlap of inferior molars on the superior is much greater than usual in the male. This contraction of the posterior part of the external border is equally marked in the female, but the posterior border is not so convex. It results from the peculiar form of the external borders of the crowns of the true molars in both sexes, that they form an echelon arrangement. This does not seem to be an adaptation to an oblique outline of the maxillary arch, which is broadly rounded as in the Australians and Polynesians.

Summarizing the above observations, I would say that in the quadritubercular molars, with distinct and divergent roots, the man of Spy takes the lowest position among the subspecies of man. Second, that in the relative proportions of the premolars and molars with each other and among themselves, he possesses some characters lower than any of the known races of man, and approximates near to the apes. Third, that in the echelon arrangement of the external wall of the molars, he presents a peculiarity more strongly pronounced than either man or apes, and whose true significance can not now be determined. It occurs in the abnormal V-shaped maxillary arch of existing men, but the arch in the man of Spy has not this character, but is fully rounded, and as it occurs in both sexes, it is not probably an abnormality.

In conclusion, it may be observed that we have in the *Homo neanderthalensis* a greater number of simian characteristics than exist in any of the known races of the *Homo sapiens*, although, so far as known, he belongs to the genus Homo. The posterior foot, so far as preserved, indicates this to be the case. The foot-character, which distinguishes the genera Homo and and Simia still remains. There is still, to use the language of Fraipont and Lohest, "an abyss" between the man of Spy and the highest ape; though, from a zoological point of view, it is not a wide one.

The flints which were discovered in the stratum of cave deposit containing the human remains, are of the paleolithic type known as Mousterien in France, which are of later origin

than the Chelléen or older paleolithic. The older paleolithic man is not yet known. It is interesting to observe that these flints (Mousterien) are of the same form as the obsidian implements which I collected at Fossil Lake, in Oregon, with the bones of extinct llamas, horses, elephants, sloth, etc. The animals which accompanied the man of Spy are, *Cœlodonta antiquitatis* (wooly rhinoceros), *Equus caballus, Cervus elaphus, Cervus tarandus, Bos primigenius, Elephas primigenius, Ursus spelæus, Meles taxus, Hyaena spelæa;* five extinct and four existing species.

As the evidence now stands, the most primitive and simian of human races inhabited Europe. No trace of the *Homo neanderthalensis* has been found in any other region of the earth. As, however, paleolithic implements are found in all continents, we may anticipate that this or some similar species of man will be discovered there also. An equally probable conclusion is that, taking into consideration the characters of the Neolithic man, the Europeans originated in Europe, and that some of us are the direct descendants of the *Homo neanderthalensis*.

EXPLANATION OF PLATE.

Dentition of the man and woman of Spy, natural size; taken from casts.

Fig. 1. Superior molars of the man from below.

Fig. 2. Do. of the woman from below; 2a do. last posterior molar from behind.

Fig. 3. Maori, last superior molar from behind.

Fig. 4. Do. of Tahitian from below; *a* do. from behind, showing fused roots.

Fig. 5. Superior dentition of a Fan from West Africa, from the collection of the University of Pennsylvania; *a* last superior molar.

Fig. 6. Inferior dentition of Fan of Fig. 5.

Fig. 7. Esquimaux, superior molars; from cranium in Army Med. Museum, Washington, D. C.

THE PROBABLE PHYSIOGNOMY OF THE CRETACEOUS PLANT POPULATION.

By Conway MacMillan.

The sudden appearance of metaspermic plants in the rocks of the Cretaceous period has occasioned much discussion, and has always proved to be a *crux* to the writers on evolutional philosophy. Even in the latest work of authority on general evolutionary topics—*Darwin, and after Darwin,* by Romanes, the old and vague statements—concerning "probable breaks in the records," and possible remarkable accelerations of what are usually very slow processes,—may be found again, and have the air of being all that can yet be said with much show of reason from the evolutional point of view. The various opponents of Darwinism, and of evolution in its broader sense, have ever appealed to the sudden emergence of Cretaceous metaspermic plants as an unanswerable argument against the different development-hypotheses. There is not space here even to cite the numerous works in which the unexplained and sudden appearance of Cretaceous metaspermic plants has been adduced in condemnation of the various evolutionary hypotheses. All students who have kept pace with the controversial biological literature of the last thirty years, will readily recall the important part that the Cretaceous plants have played in the anti-evolution polemic.

In view of what has been stated above, the intent of this paper will be recognized as a sufficiently ambitious one, when it is stated to be an effort to show two facts, as developed by the study of modern plant-formations and the evidence of the fossils; first, that the appearance of Cretaceous metaspermic plants is proved, *by the fossils,* not to have been sudden, but gradual, and consequently, in Cretaceous time, the general preponderance of plant-population was strongly coniferous, fern and cycadean; and second, that the conditions of Cretaceous time were such that the new and scattered metaspermic plants were placed under circumstances similar to those in

which to-day variation is most rapid and plasticity is greatest for each species and even for every individual.

The attempt to show that the high preponderance of metaspermic remains in the Cretaceous rocks is a sufficient proof of the high preponderance of pines, cycads, ferns and club-mosses in the Cretaceous forests is paradoxical enough to excite grave suspicions of the method by which such a result is reached, but the writer hopes to show that the absurdity of the statement is solely a superficial one, and that it is really capable of a defence both from experiment, observation and legitimate deduction. I have already presented in my recent work on the plants of the Minnesota valley the skeleton of the argument,[1] but desire here to amplify and extend the discussion, somewhat, to more fully cover the ground. If the conclusions that I have drawn are legitimate, and my knowledge of the literature of the subject sufficient to uphold my belief that certain new laws are determined, both of plant-distribution to-day and paleontological interpretation, it will be clear that the argument is an important one, and should be examined for what it may prove to be worth.

In the first place let us examine some of the observed facts of plant-distribution to-day. It is apparent that while species themselves are generally limited in some more or less definite manner and occupy a more or less considerable area of the earth's crust, there are several degrees of aggregation in which species play a subordinate part. We note the coniferous forest as distinct from the hardwood forest, the prairie knoll from the prairie swale, the mountain-side herbage and shrubbery from the herbage and shrubbery of the valley. The presence of these different zonal groups at different attitudes and latitudes was first pointed out in the modern way, by von Humboldt.[2] Since his time, the various groups of species, conditioned in some definite manner and, under climatic influences, acquiring characteristic habits or habitats, have been studied

[1] Metaspermæ of the Minnesota Valley, p. 602 (1892).

[2] Essai sur la Geographie des Plantes, suivi d'un Tableau Physique des Regions Equinoctiales.

De Distributione Geographica Plantarum, secundum cœli Temperium et altitudinem montium, Prolegomena.

somewhat in detail. The great works of DeCandolle[3], Grisebach[4], Engler[5], Drude[6], and the numerous special brochures of these and of many other writers on geographical botany, have pointed out with much distinctness the existence of plant-formations. These formations are of different degrees. In the United States there are, in the eastern portion, two very distinct formations that belong to the highest division—namely, the forest and the prairie. These two great formations, in the broadest sense, are scarcely anywhere in contact with each other, but are separated by what may be a very narrow strip of plants imperfectly developed in either forest or prairie. The region occupied by such a transitional strip of plants I have named in the work cited above, a *tension-line.* Wherever two formations of different sorts, such as hardwood forest and coniferous forest, meadow and hillside-grassland, or any other two, come together, there is such a tension-line developed along the line of contact.

The character of the tension-line between formations has received as yet very little study, and it is not possible to speak of it as exactly as one would wish. My own observations are confined to the tension-lines between forest and prairie in the Minnesota valley, a region of special study for the past two years. Certain interesting facts have been deduced. These may be noted as follows:

The plants of the tension-line consist of such species as are sparsely developed in the more central areas of the two adjacent formations, or in some cases of species very poorly developed in the solid parts of the two formations.

The number of individuals of the first group is generally greater over a given area along the tension-line than in the solid portions of the formations.

[3]Gèographie Botanique Raisonnèe, on exposition des Faits Principaux et des Lois concernant la Distribution Geographique des Plantes de l'epoque actuelle. TOM. I, II (1855).

[4]La Vègètation du Globe, d'apres sa Disposition suivant les Climats, esquisse d'une Geographie Comparèe des Plantes, trad. par P. de Tchihatchef. TOM. I, II. (1877).

[5]Versuch einer Entwickelungsgeschichte der Pflanzenwelt, insbesondere der Florengebiete seit der Tertiärperiode. TH. I, II. (1879).

[6]Handbuch der Pflanzengeographie. (1890).

There is a tendency for plants of a higher phylogenetic type to accumulate in the tension-line area than characterizes either of the adjacent formations. Thus in the border of the wood and prairie one finds Asters, Helianthi, Solidagos, predominant over the lower Archichlamydeae or Monocotyledones.

There is a transition from typically prairie groups of grasses to the typical tension-line groups of species, and similarly from the typically forest groups of trees, in the hardwood belt.

The tension line is characterized by a greater comparative richness of species and luxuriance of individuals, in the matter of number, than the average of the adjacent formations.

The tension-line is not a fixed, but a moving line, and usually one formation or the other is in a condition of encroachment while its adjacent formation is in a condition of retreat.

The movement of the tension-line is felt some distance from the contact line of the two formations, so that, if forest is encroaching upon prairie, the characteristic composites of the tension-line are thrust out farther into the prairie.

From the interior regions of both adjacent formations plants "work out" into the tension-line area. Such plants are generally the imperfectly established.

The last point lends itself very easily to direct experiment. If a field of some well established perennial plant, as for instance, blue-grass (*Poa pratensis*) be selected, and several sunflower seeds, or thistle seeds, be planted in the center of it, it will happen that one or two plants of the composite species may reach maturity, and will then distribute seed outward in every direction. In three years time the composites will probably be ejected to the periphery of the field, and will have gained there a considerable foothold, while in the center of the field they will have gained but a slight foothold, and perhaps will not have retained what they had given them at first. A strong formation thus ejects to its periphery the plants that not in harmony with it, still strive to establish themselves. In the work cited above, I have termed this "the law of the ejection of the weaker." It may be seen operating in any wood or field, and is, I believe, one of the most important factors in the

origin and modification of metaspermic species—although not generally recognized. It will be observed that while this ejection is purely biological, it nevertheless bears comparison with certain physical phenomena as when, for example, the water contained between the pores of adjacent solids is squeezed to the surface of the mass, and is thus ejected from its original, more central position.

It appears from the preceding analysis of conditions certainly existing and verifiable, that two adjacent formations do not actually come in contact, but are separated by the thicker or thinner band of tension-line species. It further appears that the tension-line group is made up of, and constantly replenished by plants ejected from the interiors of both formations, and reaching the tension-line as it were, to use a metaphor from chemical science, "in the nascent condition." This explains, or at least suggests the explanation of what otherwise would be difficult, viz., the large comparative number of species in the tension-line area, and the fact that higher types are aggregated there rather than in the solid portions of adjacent formations. For not only is the tension-area populated from the interiors of the adjacent formations, and thus comes to have a diversified group of inhabitants injected into it, but these inhabitants are likely to be the new forms, not in perfect harmony with the general mass of the formation in which they originated—and therefore they are ejected. Furthermore plants reach the tension-area "on the move"—their variations already begun and accentuated, it may be, by the forced journey to the periphery of the parent formation. Therefore both the actual numbers of species in the tension-area being great, and these species being derived from widely different habitat and environment conditions, together with the high degree of plasticity acquired in the ejection and after establishment in the tension-area, it becomes evident that it is precisely at such a contact-region between two formations that conditions are highly favorable for specific and generic and even ordinal variations to set in. Thus the increased number of species in the tension-area is seen to be in part the cause, and in part the

result, of the high variability that is experimentally noted in such an area.

From the above, the explanation of the various peculiarities of the tension-line will readily be derived. Under the law of the struggle for existence, it will be seen that this struggle may be between individual and individual, individual and formation, and formation and formation. All three phases are developed at the tension-line and since the causes of evolution are working at their highest along this area, it happens that the results are numerically most apparent. The three phases of the struggle are not elsewhere so vividly brought to one's notice, for at least the third will be wanting or felt but indirectly. It appears, as a result of the examination, that the character of the tension-line, as made out by observation, is capable of illumination by experiment and of explanation by the general and well-known laws of evolution.

It is now my intention to show that the metaspermic plant-population of the Cretaceous, and especially of the Upper Cretaceous was a tension-line population. If this be possible, we shall expect that population to manifest tension-line characteristics.

In the first place it is necessary to gain some comprehension of the Cretaceous geography. I shall concern myself here only with the Upper Cretaceous of America. At the time of the deposition of the Cretaceous clays and sandstones, the North American continent was much more restricted than now. It extended little south of Illinois, and was cut by a great Mediterranean Sea into an eastern, larger and shorter, and a western, smaller and longer continent. The Mediterranean Sea extended from the south to the extreme north, and was doubtless highly saline in character. The coasts of this sea were generally low—at least this is derived from the evidence of the flora, according to Lesquereaux—but, here and there, doubtless varied by some rocky promontory or headland. The shores were marked by frequent bays and estuaries, and the rivers which flowed into the Cretaceous oceans were probably tide-streams to a marked degree. The general character of the country was low or morassic, but this was certainly broken

by high uplifts, usually far inland. The coast-line of the ocean was therefore, so far as may be determined up to the present time, a generally low area, where vast stretches of sands or mud-flats were shifted about by the surf and by the inflowing waters of tributary streams. It is these sandy beaches and mud-flats that persist to-day as the Cretaceous rocks, bearing their countless imprints of archaic plants.

Considering next, for a moment, the character of the plant remains from the Cretaceous, we find that in the Lower Cretaceous, as studied by Fontaine, there are numerous ancient fern and cycadean types. These become less prominent in the Upper Cretaceous, so that in 1874, when, under the researches of Heer and Lesquereaux, already 130 species were described from the Dakota group, of these only five are ferns or cryptogamous plants, one doubtfully cycadean, six coniferous, two monocotyledonous, and the rest Dicotyledons—principally in the Archichlamydeæ, with only a very few (*Bicornes*, *Leguminosæ*, *Ebenaceæ*, etc.) referable to the Metachlamydeæ. The presence of the older types of cycads, conifers and ferns is important to be noted, for it is possible that the sole reason for their not appearing in countless numbers is the fact that they were cut off from the sandy-beaches and mud-flats by a thin but well-nigh continuous tension-line group of new and struggling Metaspermæ.

The study of shore-lines of modern seas is essential to the further working out of the hypothesis in process of development in this paper. The writer is not aware that observations have been made with the considerations in view that would make them useful either for support or objection. His own studies of sea-shore areas are confined to the observation of Cape Cod, Massachusetts, during a single month. While there he found that the older plants are more numerous in the inner regions, and the newer more numerous nearer the coast. The coast-line then seems to be a tension-area. While there are many pines on the Cape, these, so far as I could discover, were generally distributed inland, reaching the border of the sea only on high promontories, and on low lands being generally separated from it by strips of herbage, low shrubbery and hard-

wood timber. Further study of the sea-shore is needed along this line. But, apart from the testimony of the limited observation, it appears demonstrable that the coast-line, simply because it was peripheral, thus terminating ejections, must have developed a tension-line group of plants in Cretaceous times. That this tension-line was a relatively narrow one is proved by the great preponderance of metaspermic remains. For if it had been a broad one, the competition between older ferns and cycads, and newer metaspermic plants would doubtless have been sufficient to have brought down to the coast in larger numbers the more inland types of plants.

The picture of the Cretaceous plant physiognomy which these considerations brings before our eyes is of a great solid inland forest of conifers, cycads, ferns, and *Calamites* (?), bounded by a thin peripheral line of metaspermic trees, shrubs and herbs. This peripheral line extended up both sides of all estuaries, streams and rivers, and thus shut off the older, luxuriant and dominant flora from proper representation in the rocks of the period, as they have come down to us. An occasional inland plant was carried down some river and buried in the sands or shales at its mouth, and sometimes when the shores were high the inland types came close to the sea, and in the *Sequoias, Cunninghamites, Abietites, Zamieites* and other genera of the Cretaceous rocks, we derive a hint of the inland and general character of the plant population. The very fact, therefore, of the high metaspermic preponderance in the fossils—since it shows metaspermic plants to have been uniformly the coast population, and hence the tension-line population, is an argument in favor of supposing that metaspermic plants were actually very much less predominant in the general flora then than they were in Tertiary or Recent time.

Together with this disposition of the oft-repeated declaration that the Cretaceous Metaspermæ appeared with inexplicable suddenness, it will be seen that the other difficulty of their rapid and inordinate multiplication of species and genera is solved—so far as such notes constitute a solution. The tension-line position, with its tremendous increase of urgency to modify, and its concomitant increase of individual plasticity,

explains the matter, so far as general explanations are of value. As the Metaspermæ began to fight their way back into the solid coniferous fern and cycadean forest, doubtless the same phenomena might have been noticed that are apparent to-day. The examination of a region where hardwood forest is encroaching upon coniferous is especially suggestive. The forerunners of the hardwood trees, various herbs and shrubs, insinuate themselves up the rivers and tributaries, closely followed by the trees themselves. In this way the coniferous plants and their numerous allies, the various heaths, cornels, club-mosses, etc., are isolated into phalanxes of smaller and smaller size. At last they become entirely surrounded by the invading types, and at the first opportunity are exterminated altogether. Without question similar scenes might have been noticed in the ancient Cretaceous forest when the tension-line group of plants waxed strong and began the backward march carried on through Tertiary time and resulting in the domination to-day of archichlamydeous trees in the extra-tropical forest regions, while metachlamydeous plants are in their turn characteristic of the tension-lines.

To summarize, in conclusion, what is at best a disconnected and imperfect attempt to contribute somewhat toward the analysis of a very difficult group of problems. A study of modern plant formations reveals the presence of tension-line areas in which higher types of plants may become aggregated, and where the general tendencies are toward a high degree of individual and specific variability. Such tension-lines are peripheral in position, and may be of different degrees of organization as they lie around formations of greater or less degree of integration. Newer types of plants are particularly likely to be forced into the tension-line habitat, under the law of the ejection of the weaker. Both observation and experiment show this. Such tension-lines doubtless characterized the Cretaceous formations as well as those of to-day. In them the weaker, because newer, types were aggregated, and in this way the littoral regions of the Cretaceous oceans came in all cases to be densely metaspermic in the character of their plant-population. The generally low elevation of the coasts

contributed to this condition. The older types of plants, making up the bulk of the forest, were isolated from the shores and from the banks of streams, except very far inland. Consequently their remains are preserved only under exceptional conditions. That the metaspermic plants occupied the tension-line position indicates the preponderance of older types in the great inland stretches of country. The rapid appearance of new metaspermic types during the Cretaceous—and probably too in Jurassic time—was a result of the tension-line position into which they had been forced. The high development of the arboreal habit may be referred to similar causes.

The picture thus brought before the eyes differs much from the usual reconstructions of Cretaceous landscapes, but may be, nevertheless, a closer approximation to the truth. A final word may be added in regard to the conditions of the Triassic and even of earlier time. In those ages we may imagine the metaspermic types developing in the ancient forests of cycads —or even of *Lepidodendrons* and *Annularias*—and beginning their forced marches to the peripheral regions of the solid, archaic formations of their birth. Thus for century upon century they may have existed, and fail to appear in the fossils, because of their internal position in the formations. But when, after their long struggle for food and light and soil for support, they emerge upon the periphery of their parent formations we find them already arborescent or arboreal, and soon almost universal upon littoral areas. They then first come into a position where preservation in the rocks is possible.

AN EXTREME CASE OF PARASITISM.[1]

By Robert Hessler, A. B., M. D.

There is a small family of minute animals belonging to one of the sub-divisions of the arthropods which is of especial interest on account of the parasitic habits of many of its members. One of these, *Sarcoptes scabiei* De G., is parasitic on the genus Homo.

Historical.—It seems that the Jewish physicians dwelling among the Moors of Spain, in the 12th century, knew something about these animals and their causative relation to the affliction known as the itch. The discovery of the microscope early in the 17th century (1619) led to many investigations, some of which had reference to the itch mites. The first good description of the mite bears the date of 1687, and was written by Bonomo to Redi, at Florence. After this, various observers saw the insect, but frequently it was confounded with other mites, especially the cheese mite. Linnæus in his Systema Naturæ, 1734, had a very imperfect idea of it.[2]

In the century following the first appearance of the Systema Naturæ, the mites, as causes of the itch, were frequently the subject of heated discussions among medical men. The identity of the human itch mite was better known to naturalists than to physicians.[3] For instance, in a large treatise on skin diseases by P. Rayer, originally published in Paris in 1835, the author, in describing the causes of the itch, says: "Causes —Scabies is one of the most universally disseminated contagious diseases known; the most momentary contact of the fluid secreted by its vesicles is enough to communicate the infection; it is observed in every climate during every season of the year, attacking all ages and persons in every rank of life, without discrimination. It is most commonly observed, however, among the poor and wretched," etc. Further on he

[1] Read before the Indiana Academy of Science, December 28, 1892.

[2] Hebra, "Diseases of the Skin," 1868. P. 168–180.

[3] Hebra, "Diseases of the Skin," 1868. P. 180–181.

says: "Several authors of modern times have reported that they have discovered an apterous insect, almost invisible to the naked eye, within the vesicles of scabies, which they have described under the name of acarus scabiei," etc. The author does not state whether he believes this.[4]

The labors of many observers in 1834 and 1836 firmly established the true nature of the itch or scabies. In 1845 and 1846 the minute anatomy of the insect was thoroughly studied and described.[5] The mite *Sarcoptes scabiei*, as the cause of the itch, was established beyond all doubt.

In recent medical works, I find there is little uniformity in regard to the systematic classification of this animal and its generic and specific names. The latter are variously given, the most popular seems to be *Acarus scabiei*. Frequently, all the different names are given. A recent treatise has it thus: "The acarus scabiei, sarcoptes scabiei, or sarcoptes hominis, commonly called the itch mite."[6] Authorities for names are never given. The accounts of the animal are often very brief and unsatisfactory. The size of the mites is variously given. According to some it is "very minute, almost microscopic;" according to others, "the size of a pin head." The pictures or figures of the mite differ greatly. In one work consulted—a standard text-book by the way—an entirely different mite is figured.[7] From the great numbers of mites which I had for comparison, I may say, without going into invidious distinctions, that the best figures I have seen are those in Taylor's "Atlas of Skin Diseases." Dr. Piffard's atlas contains an excellent photo-micrograph of the female acarus.

The itch mite is now universally called by entomologists Sarcoptes scabiei De Geer. The names Acarus scabiei and Sarcoptes hominis, given in many medical works should be dropped. Acarus and acari as synonyms for mite and mites are, of course, allowable.

The best description of the mite I have seen is Hebra's. It runs: "Body oval, tortoise-shaped, with indentations in the

[4] Reyer, "Diseases of the Skin" (John Bell), 1845. P. 135–136.

[5] Hebra, "Diseases of the Skin." P. 187–489.

[6] Shoemaker, "Diseases of the Skin," 1892. P. 700.

[7] Frey, "Microscope and Microscopical Technology," Cutter, 1880. P. 562.

lateral margins. Skin provided with shallow, undulating, transverse furrows. Dorsal surface covered with numerous small and large appendages of a clavate or conical form, or resembling scales, and with spines resting on papillary elevations. Head apparently distinct from the trunk, with four pairs of jaws, and two strong, three-jointed palpi, placed near the jaws, and of the same length. Legs eight in number, five jointed; the first and second pairs provided with pedunculated suckers—the peduncles of the same length as the legs themselves, and having no joints; the third and fourth pairs in the female terminating in long bristles. In the male, the first, second, and fourth pairs of legs are all provided with suckers, the third pair alone having bristles; the epimera of the first pair united. Larva presenting six legs—the first and second pair with suckers, the third pair terminating in long bristles." In regard to size, Hebra says: "The adult acarus varies in size. On an average, its length is 0.45 mm.; its breadth, at the fourth ring of the thorax, 0.35 mm. The male is considerably smaller than the female. In length it measures 0.23 mm.; in breadth, 0.19 mm. The eggs of the itch mite are of an ovid form, and are 0.16 mm. long, 0.11 mm. broad." It is, perhaps, unnecessary to say that the size of the animal is entirely out of proportion to the commotion it occasions when its presence becomes known.

The presence of the mite on the human body is characterized by certain appearances and symptoms known as 'scabies' or 'itch'. Scabies comes from scabere, to scratch. "The name of 'scabies' is, at the present day, used to designate the numerous appearances produced on the skin by the presence of acari which dwell within it, and which, in obtaining food for themselves, and in propagating their species, give rise to a continual irritation of its component tissues. The morbid appearances themselves resemble, in many respects, those caused by other irritants, but, taken as a whole, they nevertheless present certain peculiarities, which justify our making of them a distinct form of disease" Hebra.[8]

"Though the (*Sarcoptes scabiei*) is the essential cause of scabies, it must be remembered that eruptions almost, if not wholly

[8] Hebra, "Diseases of the Skin." P. 192.

identical, are produced by other species of the Sarcoptes derived from horses, dogs, cats, camels, sheep and rabbits."[9] Such cases are, however, rare.

It is, perhaps, unnecessary to add that the mite is never found in the body, only upon it, never in the organs or in the blood.

The human itch mite is perhaps coeval with man. It has certainly always existed as far back as written history goes.

Hebra, for good reasons, believes that many of the afflictions of the Israelites, as mentioned in the Old Testament, were nothing other than the itch.[10] Aggravated forms no doubt frequently occurred. Geologically speaking, the mites, as a group, are of recent appearance (Garman).[11]

The itch is, at the present time, becoming one of the rarer afflictions of mankind—like all filth diseases, it is gradually disappearing.

(In his Atlas of Skin Diseases (p. 319), Doctor R. W. Taylor says: "Until a few years ago, scabies was a rather uncommon disease *in this country*, but it has been noticed that in the various large cities and in some small communities, there has been of late, a remarkable increase in its prevalence." *Italics mine.*

In a recent letter to the writer, he expresses the belief that this is mainly due to the influx of Russian and Polish immigrants.

Cases are seldom seen outside of the slums of large cities; but it sometimes happens that if a case occur, say in a small town where none had appeared for years, perhaps half of the population becomes affected before its true nature is known, and appropriate remedies are applied. Vigorous medical treatment soon blots out an epidemic.

In an ordinary, acute or epidemic case of itch, the number of mites is quite small, probably not exceeding one hundred adult animals.

[9] Taylor, "Atlas of Skin Diseases." P. 327.

[10] Hebra, "Diseases of the Skin." P. 164–166.

[11] "Insect Life." Vol. IV., P. 182.

Recently I met with an extreme and rare case of the itch,[12] brought about by the presence in the skin of an immense number of itch mites. It shows to what extent parasitism will go under favorable conditions. The first detailed description of this rare form of itch was made by Hebra, of Vienna, in 1852, and who gave it the name of Scabies norvegica, or Norway itch, because the case was from Norway. Since then, other cases have been seen at various times and in different places, still, it is so rare that modern treatises on skin diseases do not describe it. Taylor's large "Atlas of Skin Diseases," devotes just two lines to it, as follows: "European writers, particularly of previous decades, have described a severe form of encrusted eczematous scabies, which they call Scabies norvegica, or Norway itch. It is not seen in this country."[13]

DESCRIPTION OF THE CASE.

The host of the mites was a middle-aged white man; he was partly paralyzed, and hence comparatively helpless. At the time of his admission to the City Hospital, his entire body was covered with thick, yellowish-white, leathery scales, the largest measuring over one inch in diameter, and over one-tenth inch in thickness. He was literally covered with scales like a fish.

On rubbing the body slightly, a large quantity of these scales fell off; rubbing more briskly removed an additional quantity, but with the production of small bleeding places (these scales were not crusts or scabs, they were epithelial proliferations). At a few places on the body crusts were found, mainly where the skin was bent, as at the joints. On account of the bleeding, no vigorous mechanical treatment was used at any time; the scales were gently rubbed off. A handful could be gathered daily. Despite this great alteration of the skin, the general health remained good. Taken in its entirety, the case was a puzzling one.

In a search for the cause of this eruption, and as an aid to the determination of the disease, some of the scales were sec-

[12] The case was described from a medical standpoint in the *Indiana Medical Journal* for November, 1892, by Dr. Brayton and myself.

[13] Taylor, "Atlas of Skin Diseases." P. 327.

tioned. Itch mites were found in abundance, and the nature of the disease was soon established.

In order to study the case more thoroughly, a number of the scales were prepared by usual histological method. The scales were fixed and hardened by immersion in alcohol, stained in picrocarmine, finally imbedded in paraffin, sectioned, affixed to slides with clove-oil collodion, and mounted in series. The shrinkage in passing through this process was very slight. The differential staining in this case was peculiar: the epithelium stained red, the mites yellow; the eggs remained unstained, that is, white; the fæces appeared dark brown or black. In staining sections of normal skin with picrocarmine, the outer or horny layer stains a bright yellow, the underlying protoplasmic layers stain more or less deeply red. In the present case the epithelium is peculiar in that well-stained sections show very little yellow; this indicates that the component cells are still protoplasmic, and have not cornified.

The activity going on in the columnar layer to replace this constant and enormous loss of cells must have been great. Apparently a vicious circle was established; the presence of the mites irritating the skin—the skin, to protect or rid itself from the parasites, pushed out a large number of new cells. These succulent cells, however, furnished a good nidus for the mites. The mites increased, causing increased irritation of the skin, and this caused an increased proliferation of cells. Thus the case went on, until it assumed this extreme form.

I may here say, that under appropriate anti-parasitic treatment at the hospital, the mites were soon exterminated. The cause of the irritation once removed, the skin gradually regained its normal character.

Number of Mites.—In order to obtain an idea of the number of mites present on the host, that is, at the time the mites were present in greatest numbers, several scales were cut to measure one-half by one-eighth inch, sectioned and mounted serially. It will be readily understood that in such a procedure the mites were cut in various planes and directions; sometimes the head would be seen in one section, the body in one or two other sections, and the tail in still another. Many of the smaller embryos and eggs appeared entire.

Anyone who has attempted to get numerical results from serial sections, will understand the difficulty of obtaining approximately correct figures. In the present case, two counts were made in each of three series of sections, and the mean of these counts was taken as an approximately correct number. Here are the figures:

Eggs and egg cases, 380.
Mites in all stages of development, 109.

Assuming that the above figures are approximately correct, we can make a little calculation: Multiplying the above numbers by 16, gives the number for one square inch; again multiplying by 144, gives the number for one square foot.

The average amount of epithelial covering on an adult human being, is said to be about 16 square feet. To be on the safe side, we will say that only half of the body was covered with scales, therefore, multiplying our last figures by eight, gives the number of eggs and egg-cases and mites on the host at the time of greatest abundance. Here are the figures in round numbers:

Egg cases and eggs, 7,000,000.
Mites, 2,000,000.

Since the reading of this paper, I tried to determine the proportion of eggs which are empty, that is, hatched. It seems that from one-half to three-fourths are empty shells.

As to the number of *living mites* in the shed scales. This is a difficult question. I am inclined to believe that only a small proportion were alive at the time the scales became detached.

Indianapolis Ind.

ON THE RELATIONSHIPS AND DISTRIBUTION OF THE NORTH AMERICAN UNIONIDAE, WITH NOTES ON THE WEST COAST SPECIES.

By Chas. T. Simpson.

For some years past, it has been generally acknowledged by students of the Unionidæ that a more natural system of classification was needed for that family than any that has hitherto been offered.

The genera or sub-genera of Rafinesque, Swainson, Agassiz and Conrad are of little value, for while certain typical species may be fairly referred to their divisions, in many others the characters fade out, or so blend together that it is impossible to place them, and sub-generic lines cannot be drawn with any degree of accuracy. Lea's arrangement, in which he divided the genera into two great groups, characterized by the presence or absence of a dorsal wing on the shell, and then into smaller divisions based on sculpture and form, was, like the Linnæan classification in botany, almost entirely artificial, consequently in many cases it brought together side by side forms not at all nearly related, and in others it widely separated those having close affinities, or even sometimes individuals of the same species.

I believe that the best and simplest system that can be adopted at the present, at least, is to place those species, which by the characters of the shell, by what we know of those of the animal, and by the facts of geographical distribution are most nearly related, in groups, each founded on and taking its name from some common, characteristic, and widely distributed form. Thus *Unio gibbosus*, which is nearly everywhere found throughout the Mississippi drainage area, is well known to every collector who has only a few species of Unios, and, with its elliptic oval and sometimes arcuate outline, thick epidermis, heavy cardinal and solid club-shaped lateral teeth, fairly typifies an assemblage of forms found from Canada to Central America, and from the Missouri river to Florida. *Unio liga-*

mentinus represents another section, *Unio complanatus* another, *Margaritana margaritifera* a fourth, *Anodonta ovata* a fifth, and so on.[1]

This plan of grouping by relationships is not a new one, having been adopted by R. Ellsworth Call, Wm. A. Marsh, and other students of the Unionidæ in the arrangement of their collections, and even Mr. Lea acknowledged some such affinities, though he did not put his ideas into practice.

It is found that a common assemblage of Unionidæ inhabits the entire Mississippi drainage basin, and that a considerable number of the species have a distribution covering the greater part of this area, as well as the whole of Texas, and even parts of eastern Mexico.

Those streams which fall into the Atlantic are peopled by an entirely different set of forms, the Appalachian chain seeming to act as a sharp barrier between the two regions. Many of the Mississippi Valley species have spread into Michigan, a few into Canada, into streams in New York that flow into the Atlantic, and two or three of these are met with in the Red River of the North, and the waters about Hudson Bay; while below the southern end of the mountain range, there is another mingling of groups.[2]

There are some forms which, apparently, may be with equal propriety assigned to either of two or three groups, but, in such cases, the location of the species with regard to drainage often gives us a key as to its relationship. There is a group of oval, rather smooth, compressed Unios, which may be fairly typified by *U. favosus*, which is found in the rivers from North Carolina to Alabama, several members of which very strongly

[1] With such an arrangement, I believe that the North American Unios would fall into something like forty quite natural assemblages, whose group characters agree fairly well with their distribution so far as drainage areas are concerned. There would be some half dozen sections of ***Margaritana***, and ten or a dozen of *Anodonta*.

[2] In many cases, the Unionidæ seem to have had no difficulty in migrating across the country from river to river; an example of this being the Mississippi Valley species which now inhabit all the rivers of Texas, and some of those of Eastern Mexico; while on the other hand species of South America extend up into Central America. The embryos, in some cases, may be carried by aquatic birds in the manner elsewhere mentioned in this paper; in others, they probably migrate across overflowed regions near the sea, in time of floods.

resemble some of those of the Clavus Group, but the species of the latter assemblage are confined, with one or two exceptions, to the streams of the Mississippi Basin, while those of the former belong entirely in waters falling into the Atlantic or the Gulf. Another small group of rounded or oval inflated forms typified by *U. irrasus* likewise approaches in a few of its members some of the species of the *clavus* Group, but it is confined, so far as my knowledge goes, to the waters of the Gulf drainage; the Etowah, Coosa, Chattahoochee, and a few neighboring streams, and not a specimen has, I believe, ever come from Tennessee or the rivers emptying into the Atlantic, though several of them rise near the Chattahoochee.

In Mexico and Central America, a totally different Unio fauna is found. Some of the Anodons extend into South America, and others belong to groups that have their metropolis on that Continent, while at the North there is a greater or less mingling of the species with those of the Mississippi Valley.

I have been greatly puzzled to account for the origin and relations of the few species found on the Pacific slope of North America. Two Unios, one Margaritana, and some half dozen Anodons, are all that have been hitherto credited to this immense region. Of the latter, *Anodonta wahlametensis, A. nuttalliana, A. oregonensis,* and *A. californiensis,* are believed by Dr. Stearns[3] and other competent conchologists to be merely variations of one species, although they often differ greatly in forms and general appearance. *A. wahlametensis* is provided with a wide dorsal wing, which gradually fades out through the other forms in the order I have given them, to *A. californiensis,* which is nearly or quite destitute of this appendage. This very abundant species is found from the Rocky Mountains on the east—in all the waters draining into the Pacific—to the coast, and from British Columbia on the north, well into Mexico on the south. Six shells in the collection of the United States National Museum (Mus. No. 117951), which were identified by Dr. Stearns as *Anodonta californiensis,* were collected by Mr. Duges in the Province of Oajacay.

[3] See paper on the History and Distribution of the Fresh Water Mussels, and Identity of Certain Alleged Species, by R. E. C. Stearns, Proc. Cal. Acad. Sci., Nov. 20th, 1882.

To the northward, this seems to be replaced by *Anodonta kennerlyi*, a species closely resembling some of the varieties of *A. cygnea* of Europe, and in Alaska another nearly related form, *A. youkonensis* of Lea, is met with. The latter is an absolute synonym of *A. herculea* Midd., of which specimens are in our collection, obtained in Kamschatka by Dr. Dall. I had noticed the resemblance of all these forms to that of the well known, abundant, variable, and widely distributed *Anodonta cygnea* and its variety *anatina*, and on hunting up the distribution of that species, I have been able to trace it through Northern Asia into Eastern Siberia. Any one who will carefully examine an extensive series of *Anodonta cygnea, anatina, herculea, youkonensis, kennerlyi, wahlametensis, nuttalliana, oregonensis*, and *californiensis*, cannot, I think, fail to notice their remarkable resemblance in many essential points: the peculiar and usually exact rounding of the anterior end of the shell, the flattening of the umbonal region, which, in good specimens, is generally overlaid with hair-like, greenish, radiating, wavy lines, and the singular cutaway in the posterior slope, all indicate close relationship, and the fact that they have sprung from a common origin.

I should unhesitatingly place these forms in a natural group, typified by *Anodonta cygnea*. Dr. Stearns, in the paper to which I have already alluded, believes that *Anodonta wahlametensis, nuttalliana, oregonensis*, and *californiensis*, are but variations of the European *A. cygnea*, and that *A. fluviatilis* of the Atlantic drainage is probably but another form of this protean species.

While I was formerly inclined to this view, a more careful and thorough examination of large quantities of material has induced me to somewhat modify my opinions. Though the *nuttalliana* and its variations are very close to *cygnea*, I do not, at present, feel justified in uniting them specifically, and I regard the *A. fluviatilis* as the type of a rather nearly related group, having a distribution from Canada to Florida, in the streams which fall into the Atlantic. The shells of this section are generally more inflated than those which belong with *cygnea;* they are not flattened at the umbonal region, and are more full on the dorsal slope.

If I am right in this view of the case, it is probable that the group of *Anodonta cygnea* is confined in North America to the Pacific slope, and that its connection with the rest of the species in the Old World was made over a land passage between Asia and North America. Dr. Theodore Gill informs me that the boreal fresh-water fishes of the Old World and those of the western slope of our continent have a similar distribution to the *cygnea* group of Anodons as I have outlined it.

One of the most remarkable of the Unionidæ, *Anodonta angulata*, is an inhabitant of the waters of Oregon, Washington, and California. The anterior end of this species in ordinary specimens is much narrowed; the posterior is wide and inflated, and, running from the beaks to the posterior ventral regions is an extraordinarily developed sharp-edged ridge or keel. Nothing in the least resembling this peculiar form has hitherto been found. But the National Museum possesses specimens in which the anterior end is wider, and the keel is far less developed, and others in which it is almost entirely wanting, and that indefatigable collector, Mr. Henry Hemphill, has sent me a photograph of a specimen in his collection which has no vestige of a ridge, but is furnished with a slight groove running down the posterior slope. Recently, Messrs Mearns and Holzner, of the International Boundary Commission, have sent to the National Museum a large number of specimens of what is apparently a new species of Anodonta, from San Bernardino Ranch, Arizona, which, externally, very much resembles some of the varieties of *Unio complanatus*, but has a very different texture, and, on comparing these shells with Mr. Hemphill's photograph, and the more compressed specimens of *A. angulata*, I was convinced at once that they group together. They have the same outline, the same beak sculpture, and, when viewed from the dorsal or ventral region, have a much greater diameter through the posterior area than elsewhere, and nearly all exhibit the slight groove I have mentioned.

The type of *Unio oregonensis* was presented to Mr. Lea by Mr. C. M. Wheatley, and the former mentions that the latter reserved a specimen for his own collection. Lea's shell is said to come from the Columbia River, and is in rather bad condi-

tion, as it is dead and somewhat eroded. I have very carefully examined it, and after comparing it with everything that I could think might be related to it, I have come to the conclusion that it is a form of the protean *Unio luteolus.*

This is the most abundant, widely distributed, and variable Unio in the world, being found almost everywhere throughout the 1,200,000 square miles of the Mississippi drainage basin, through Texas, and probably into Mexico, in New York in some of the streams that flow into the Atlantic, and northward in the vicinity of Hudson Bay, and probably throughout the British possessions east of the Rocky Mountains. I have traced it up the Missouri River to near its source, and when it is taken into consideration that the Marias, a tributary of this stream, heads within a few miles of Flathead Lake on Clarkes River, a branch of the Columbia, and that the embryos of Unios are provided with hooks by which they can attach themselves to the feet or feathers of aquatic birds, it is very easy to see how this species might have been carried from the waters of one drainage system to those of another. *Margaritana margaritifera,* which inhabits Europe, Northern Asia, and the Pacific slope of North America, is also found in the upper Missouri. Two specimens of *Unio luteolus* in the Museum collection, from the North Shore of Lake Superior, are almost exactly like Lea's type of *U. oregonensis.*

So far as I am aware, nothing is stated of *Unio famelicus,* the other Pacific slope species, save that Gould received his type from Dr. Pickering, and that it is said to have come from Walla Walla, Oregon. The type is in the National Museum, *and is undoubtedly a young Unio ellipticus* Spix, from Brazil, a species belonging to an extensive South American group, characterized by having oblong, compressed, sulcate shells, which are often granulated on the ridges. Any one familiar with Unios would know at once on carefully examining the type, that it came either from South America, or some part of the Southern Hemisphere of the Old World, a fact which is made evident by its form, its peculiar greenish olive epidermis, the strong growth lines, and, most of all, the compressed, parallel, cardinal teeth of the right valve. It is perfectly safe to say that the locality given is an error, and that this species was never found in the United States.

EDITORIALS.

EDITORS, E. D. COPE, AND J. S. KINGSLEY.

—STATISTICS as to the publication of original books by the four leading nations of readers have recently appeared. America and Great Britain have published during the last decade between four and five thousand books each. In America the proportion of fiction was considerably larger than in Great Britain. In Germany the number of books published in the same time was over ten thousand, with a smaller absolute number of works of fiction than in Great Britain. The figures for France fall between those of Great Britain and Germany.

In view of the fact that America exceeds in population each of the countries named, and includes in this population a greater number of readers, these statistics are not pleasing to our national pride. Great Britain, with a much smaller population, is our superior in the quality of books produced, and yet falls far behind Germany.

There are several reasons for this state of affairs. One is the absence of compulsory education, which exists in an effective condition in Germany. Another, and probably more efficient cause, is the fact that our publishers think it necessary to bring out books of value in an expensive style, so that they are out of the reach of students generally. The same cause probably conduces to the depression in the publishing business in Great Britain. If American students could purchase scientific and other serious books at as low rates as can be done in Germany, the general standard of intelligence would be greatly elevated. If American publishers would get out cheap editions of such literature they would greatly profit by it. The extravagant style in which popular scientific books are published in this country is an anachronism. There is no nobility here whose attention it is necessary to gain for material reasons, nor is social position the object for which the scientist is supposed to be striving. Hence the absurdity of clothing science in a garb which can attract a small class only, while it makes her inaccessible to the mass of mankind. The supposition that people will not buy solid literature is negatived by the experience of Germany. If American publishers will not publish cheap works of this class we shall become dependent on foreign countries, whose books will soon become accessible to us by the removal of the oppressive tax on intelligence, known as the protective tariff.

—We have received the first number of the New Journal of Geology published by the geological faculty of the University of Chicago, and printed by the press of the University. It is edited by six members of the United States Geological Survey, together with twelve associate editors, of whom five are Americans, and one resides in each of the following countries, viz.: Canada, Great Britain, Germany, France, Austria, Norway, and Sweden. The articles of the number are by Messrs Geikie, Holmes, Williams, Chamberlin and Salisbury, and are all of much interest. Editorials, Reviews, Abstracts, and Acknowledgments follow. The beginning of this new journal is auspicious, but it remains with the future to determine whether it can be continued on its present basis. On the face of it the proposition is broad, but the basis is narrow. The names of the associate editors indicate cosmopolitan aspirations, but "the immediate editorship," we are told in the announcement, "will rest with the geological faculty of the University of Chicago," who are all members or ex-members of the U. S. Geological Survey. The leading article is by a foreigner, but this is appropriate in a city which has legal holidays in honor of William of Germany and Saint Patrick. We will observe with interest whether such a constitution can stand the test of time, or whether it will meet the difficulties which befel the image of the prophetic vision, in which the geological order was reversed, since the head was of archean gold, but whose feet were of glacial clay. Not but that the precious metal may be found in the superficial stratum in this instance; but placer deposits in glacial drift are not as permanent as those of greater geologic age. We have an excellent geological magazine, the American Geologist, which is not identified with any institution or institutions, and whose editorial corps is not interested in supporting geological literature in other countries. While, therefore, we welcome all additions to scientific periodical literature, it is always with a reservation which requires that they shall be viable infants, endowed with a good constitution.

—A movement is on foot in New Zealand to secure an island not far from the coast as a preserve for the native animals and plants of that country. In view of the extreme importance to biological science of the preservation of the remarkable types of this ancient flora and fauna, and in view of the other fact that many of its representatives have become extinct within recent times, and others are disappearing, we sincerely hope that this effort will be successful. If there is any doubt about it, a concerted effort should be made by the scientific men of all countries to secure favorable action from the colonial legislature.

RECENT BOOKS AND PAMPHLETS.

ALLEN, H.—On a New Subfamily of Phyllostome Bats.——Description of a New Genus of Phyllostome Bats.——On Temminck's Bat, *Scotophilus temminckii*. Extr. Proceeds. U. S. Natl. Mus., Vol. xv. From the author.

Biennial Report of the Director of the Illinois State Laboratory of Natural History, 1891–1892.

BOLLMAN, C. H.—Description of *Fontaria pulchella* from Strawberry Plains, Tenn. Extr. Proceeds. U. S. Natl. Mus., 1888. From the author.

BONAPARTE, R.—La Novège et la Corse, résumé de la conférence. Extr. Le Globe Journ. Geog., T. 28, 1889. From the author.

BRIGHAM, A. P.—A Chapter in Glacial History with Illustrative Notes from Central New York. Extr. Trans. Oneida Hist. Soc., 1892.

—— The Geology of Oneida County, New York. Extr. Trans. Oneida Hist. Soc., 1887–'88.

——Rivers and the Evolution of Geographic Forms. Extr. Bull. Am. Geog. Soc., 1892. From the author.

Bulletin of the Illinois State Laboratory of Natural History, Vol. iii, 1892.

BURMEISTER, G.—Anales del Museo Nacional de Buenos Aires para dar á conocer los objectos de Historia Natural Muevos ó Poco Conocidos conservados en este establecimiento. Entrega Decimaoctava, 1891. From the author.

CROOK, A. R.—Ueber einige fossile Knochenfische aus der mittleren Kreide von Kansas. Separat-Abdruck aus Palaeontographica, xxxix, Band, Stuttgart, 1892.

CROSS, WHITMAN.—The Post-Laramie Beds of Middle Park, Colo. Extr. Proceeds. Col. Sci. Soc., 1892. From the author.

DORSEY, J. O.—The Cegiha Language. Contributions to North American Ethnology, Vol. vi, Washington, 1890. From the Dept. of the Interior.

EARLE, C.—A Memoir upon the Genus Palæosyops Leidy and Its Allies. Reprint Journ. Phila. Acad., Vol. ix, Oct., 1892.

——Revision of the Species of Coryphodon. Extr. Bull. Am. Mus. Nat. Hist., Oct., 1892.

——The Variability of Specific Characters as Exhibited by the Extinct Genus Coryphodon. Extr. Science, July 1, 1892. From the author.

FOSHAY, P. M.—The Fertility of Hybrids. Extr. Medical News, 1892. From the author.

GARMAN, H.—A Synópsis of the Reptiles and Amphibians of Illinois. Bull. Ill. State Laboratory, Vol. iii, 1892. From the author.

GARNIER, DR.—The Reptiles of Canada. Extr. The Land we Live In. From the author.

GEINITZ, H. B.—Bericht über die neue Aufstellung in dem königl. Mineralogischen Museum zu Dresden. Sitzung der Gesellschaft Isis in Dresden, April, 1892. From the author.

GILL, TH.—On the Proper Generic Name of the Tunny and Albicore. On the Psychrolutidæ of Guenther. Extr. U. S. Natl. Mus., 1888. From the author.

HAYES, C. W.—Report on the Geology of Northeastern Alabama and Adjacent Portions of Georgia and Tennessee, 1892. From the author.

HOLM, TH.—The Flora of the Dakota Group. Extr. Botanical Gazette, Vol. xvii. From the author.

HOWES, G. B.—On the Affinities, Interrelationships, and Systematic Position of the Marsipobranchii. Extr. Trans. Biol. Soc. Liverpool, Vol. vi.

——On the Pedal Extremity of the Dorking Fowl, with Remarks on Hexadactylism and Phalangeal Variation in the Amniota.——Notes Upon the Shoulder Girdle of Certain Dicynodontid Reptiles. Extrs. Jour. Anat. and Physiol., Vol. xxvi.

——On the Arrangement of the Living Fishes, as based upon the study of their Reproductive System.——On the Customary Methods of Describing the Gills of Fishes. Read at the Cardiff Meeting of the British Assoc., 1891.

HOWES, G. B., AND J. HARRISON.—On the Skeleton and Teeth of the Australian Dugong. Read at the Edinburgh Meeting of the British Assoc., 1892. From the author.

JORDAN, D. S.—List of Fishes collected by Alphonse Forrer about Mazatlan, with descriptions of two new species, *Heros beanii* and *Pœcilia butlerii*. Extr. U. S. Natl. Mus., 1888. From the author.

KEYES, C. R.—Iowa's Natural Resources. Extr. Iowa State Register, July 12, 1892. From the author.

LYDEKKER, R.—On a Collection of Mammalian Bones from Mongolia. Extr. Records Geol. Surv. India, Vol. xxiv, 1891. From the author.

MACOUN, J.—Catalogue of Canadian Plants. Part VI, Musci. From the author.

NEWTON, E. T.—On a Skull of *Trogontherium cuvieri* from the Forest Bed of East Runton, near Cromer. Extr. Trans. Zool. Soc. London, Vol. xiii, Part IV, 1892.

——The Vertebrata of the Pliocene Deposits of Britain. Extr. Mem. Geol. Surv. of the United Kingdom, 1891. From the author.

NIBLACK, A. B.—Ethnology of the Coast Indian Tribes of Alaska. Extr. Proceeds. U. S. Natl. Mus., 1888. From the author.

POCTA, PH.—Ueber Spongien aus der oberen Kreide Frankreichs in dem k. Mineralogischen Museum in Dresden, mit Vorwort von Dr. H. B. Geinitz. From the author.

POUCHET, M. G.—Nouvelles observations sur la Sardine océanique. Extr. Comptes rendus, juillet, 1889.

Quarterly Bulletin of the University of Minnesota.

Report of the Commissioner of Education, 1888–'89, Vol. i. From the Dept. of the Interior.

ROHON, J. V.—Die Obersilurischen Fische von Oesel. Mém de l'Acad. Sci. de St. Petersbourg, vii E Serie, T. xxxviii, No. 13, 1892.

——Ueber Pterichthys. Separat-Abdruck a. d. Verh. d. Russ. Kais. Miner. Ges. zu St. Petb., Bd. xxviii, 1891. From the author.

SABLON, L.—Nos Fleurs. From Armand, Collin & Cie, Editeurs, Paris, 1892.

SCHELLWEIN, E.—Die Fauna des Karnischen Fusulinenkalks, 1. Aus Palæontographica, Neununddreissigster Band. Erste Lieferung, Stuttgart, 1892.

SEARS, J. H.—Geological and Mineralogical Notes, No 5. Extr. Bull. Essex Inst., 1892. From the author.

SIMPSON, C. T.—Notes on the Unionidæ of Florida and the Southeastern States. Extr. Proceeds. U. S. Natl. Mus., Vol. xv. From the Smithsonian Institution.

Smithsonian Report U. S. National Museum, Part II, 1886; Part II, 1887. From the Museum.

TODD, J. E.—Notes on the Geology of Northwestern Iowa. Extr. Proceeds. Iowa Acad. of Sciences, 1891.

——Striation of Rocks by River Ice. Extr. Am. Geol., Vol. ix, 1892. From the author.

TRUE, F. W.—An Annotated Catalogue of the Mammals collected by Dr. W. L. Abbott in the Kilimanjaro Region, East Africa. Extr. Proceeds. U. S. Natl. Mus., Vol. xv. From the Smithsonian Institution.

United States Commission of Fish and Fisheries, Part xvi. Report of the Commissioner for 1888.

WHITEAVES, J. F.—The Orthoceratidæ of the Trenton Limestone of the Winnipeg Basin. Extr. Trans. Roy. Soc. Canada, Vol. ix, 1891. From the author.

RECENT LITERATURE.

The Woodland of the Southwest, by Chas. F. Lummis.[1] —For those readers who have read but a few books of travel on the Southwest, this snug little volume will be quite a revelation. The contents of the twenty-two chapters scarcely contain anything that has been written or sketched before, except a few pages on the Moqui Snake dance and Indian superstitions. The thoroughness of his familiarity with Pueblo customs and folklore is only equalled by the graphic qualities of his style. In looking about the "strange corners" which the author describes, we are first attracted by a prairie-dog hunt, with the Navajo Indians put in scene to fill their larder. White people of the Southwest never think of killing this rodent for food, because it is so difficult to attain with a rifle ball; but these natives utilize abundant downpours of rain to conduct the floods into their tunnels and afterward haul up their dead bodies for a feast. To get rid of the prairie-dog plague, people have proposed to kill them with poisoned apple-quarters. The belief in witchcraft is as potent among the whites and Indians of New Mexico as it ever was during the middle ages. Manslaughter is committed for any act arousing even the suspicion of witchery, and the fact that one-half of the Isleta people are wizards and witches speaks loud enough. The "Finishing an Indian Boy" shows principles of education in full force now, which our Northern Indians began to drop as early as one century ago. In the chapter "The American Sahara" the wide waste is delineated in colors none too sharp or cruel. Lieut. Wheeler is mentioned by mistake as its earliest explorer instead of Lieut. Whipple. The marvelous wealth of objects presented in Lummis's volume will attract ever and again the class of readers and tourists which seeks instruction rather than pleasure in books of travel, and they will hold it dear as a publication of really scientific value, standing far above most of the productions of our present sensation-loving period of literature.

"The Wanderings of Cochiti" is another very interesting sketch from our "Wonderland" on the upper Rio Grande. It is printed in the "Century Magazine," January, 1893, and describes and also pictures in photographic reproductions the people, customs, history and scenery of Cochiti, one of the Quéres Pueblos of Northern New Mex-

[1]Some strange corners of our country, the Woodland of the Southwest, p. 270. 12 mo., richly illustrated. New York, The Century Co., 1892.

ico, and the celebrated gorge of Tyú-on-yi with its rock carvings in the vicinity of that pueblo. The scene of Bandelier's archæologic novel, "The Delight-Makers," is placed in that locality.

Macmillan's Metasperma of the Minnesota Valley.[2]— In this thick, handsomely printed book, in which excellent paper and an equally excellent selection of type are manifest, we have a notable departure from the usual "report" issued from a State printing office. So unlike the State or Government reports is this volume that one has to turn to the imprint to satisfy himself that it is actually the work of the State printer. If this model is followed in the future by other State printers then indeed is this book a noble pioneer in a much needed reform in State book making.

Turning to the more important part of the book, namely its contents, we find that the author also has broken away from the traditional form and style of State reports, and has given to the botanical world a useful book. He first of all chose an area with natural boundaries, instead of one arbitrarily set off for political and not scientific purposes. In his choice of the Minnesota Valley the author seems to have been fortunate in having to deal with an area of more than usual interest, but it is likely that if in other States natural areas were studied, similar interesting features would be discovered.

The list of plants includes 1174 species and varieties, a large number when one remembers that the area covers but 16,000 square miles, and the only plants enumerated are the Metaspermæ (Angiospermæ).

These species are found in prairies and woodlands, in "meadows, marshes, swamps and bogs." There is, however, a considerable preponderance of the rolling prairies. The soils are not much varied, and the difference in altitude is little more than 1300 feet from the lowest point at Fort Snelling (688 ft.), to the highest hills in the eastern part of North Dakota (2000 ft.).

The author aims to trace the history of the flora of this valley. To him it is not enough to tell what plants occupy the territory; he seeks to show how they came to do so, from whence they came, and why they came. Accordingly we have a series of discussions such as we rarely (if ever) have had in books dealing with local floras. Thus one finds such headings as these: "The Dynamic Relations of Plants,"

[2]Geological and Natural History Survey of Minnesota. Conway Macmillan, State Botanist. *The Metaspermæ of the Minnesota Valley*, a list of the higher seed-producing plants indigenous to the Drainage Basin of the Minnesota River, by Conway Macmillan. Reports of the Survey, Botanical Series, i, Dec. 29, 1892, Minneapolis, Minnesota, pp. xiii, 826. Large octavo.

"General Features of Plant Distribution," "The General Factors in Floral Differences," "Pressures and Tensions," "Outlines of Metaspermic History in the Northern Hemisphere," etc.

Enough has been said to indicate that this work is an unusual one. It is impossible to give a summary of its many interesting chapters. Perhaps the conclusion which the author reaches that while the region is geographically central in the continent, the flora is "preponderantly southeastern," sums up the results of the work as well as any which could be given.

It remains to speak somewhat more as to the list itself. In the first place it is ultra-modern in nomenclature and arrangement. Engler & Prantl's work, "Die Natürlichen Pflanzenfamilien," is followed in the sequence of the families, so that one finds the simple Monocotyledons first (*not* the grasses, and sedges, however), and following the well-known succession of families, reaching the culmination of the Dicotyledons in the Compositæ. The manuscript of the book went to the printer four months before the Rochester meeting of botanists last year, hence it does not conform in all respects to the present rules as to nomenclature. Thus the initial date adopted for the genera is 1737, instead of 1753, and now and then one finds a specific name identical with that of the genus to which it belongs. In the preface, which bears date of Dec. 24, 1892, the author records his hearty acquiescence with the action of the botanists at Rochester, and suggests the changes which must be made in order to bring the nomenclature in the book into harmony with the present code.

A very valuable feature of the work is the fulness of citations of synonyms, with dates. Thus one finds:

LACINIARIA Hill, Syst. Veg. iv, 49 (1762).
Psilosanthus Neck. Elem. (1790).
Liatris Schreb. Gen. Pl. 572 (1791).
Calostelma Don, Sweet. Brit. Fl. Gard., 2, 184 (1838).

The following may serve to show the treatment of species:

LACINIARIA SQUARROSA (Linn.) Hill. Syst. Veg. iv, 49 (1762).
Serratula squarrosa Linn. Spec. 88 (1753).
Pteronia caroliniana Walt. Fl. Gar. 292 (1788).
Liatris squarrosa Willd. Spec. III, 1065 (1802).

Then follow many references to descriptions or lists giving localities, followed by statements as to its general and particular distribution, etc.

The book will be read with interest by all advanced botanists, and it is to be hoped that it will serve as a model for future plant lists.

CHARLES E. BESSEY.

Ridgway on the Anatomy of the Humming-Birds and Swifts.—A Rejoinder.—What I say here has reference to Mr. Ridgway's reply to my review of his "popular monograph of the Humming-Birds," which review appeared in the October NATURALIST, and his reply in the December following issue of that journal (1892, p. 1040).

In that reply Mr. Ridgway remarks that his description of the humming-bird's tongue "is substantially a condensation of MacGillivray's"[3] (in Audubon's Birds of America, Vol. iv, pp. 197, 198), and that his "knowledge of the subject is based chiefly upon it." Now one of the errors I pointed out in Mr. Ridgway's "Humming-Birds" was that he claimed the tongue in those birds was "hollow," and yet he now states that his account is a condensation of Macgillivray's lucid description. Let me contrast the statement of the two authors, thus:

MACGILLIVRAY.	RIDGWAY.
In the tongue of the humming-bird "there are, it is true, two cylindrical tubes, but they gradually taper away toward the points, and instead of being pervious, form two sheaths for the two terminal parts or shafts of the glosso-hyal portion of the tongue, which run nearly to the tip." (Aud. Birds of Amer., Vol. iv, p. 198).	In the humming-birds "The tongue is slender and very extensile, like that of the woodpeckers. * * * * * Instead, however, of its being as in the woodpeckers, solid and tipped with a barbed, horny point, it is hollow." (The Humming-Birds, p. 290).

These sentences, *in either case*, are completed by their respective authors in their calling attention to the bifurcated condition of the extremity of the tongue, and, as that is not the point in question, I purposely omitted it.

Farther on in his reply Mr. Ridgway remarks that his knowledge of the structure of the humming-birds is to some extent based upon the "later dissections of thirteen species," made by Mr. F. A. Lucas, "instead of one, as in the case of Dr. Shufeldt's 'extensive dissections.'" If my friend will again allow me to invite his attention to the literature of the subject, I would call it to my memoir published in

[3]If Mr. Ridgway will permit one who has long been familiar with the works of "the Scotch anatomist," I would "kindly invite" his attention to the fact that that careful dissector of birds spelled his name Macgillivray, and *not* MacGillivray, as Mr. Ridgway always writes it.—R. W. S.

the *Linnean Society's Journal*, Vol. xx (London), pp. 303, 304, where he will find that I had the following material for my "extensive dissections," namely, spirit specimens of *Cœligena clemenciæ, Trochilus colubris, T. alexandri, T. anna, T. platycercus, T. rufus, T. calliope* and *Iache latirostris*—in all 3 genera, 8 species, and 62 specimens. When this material was presented by me to the collections of the U. S. National Museum, Mr. Lucas remarked that it was the largest and best collection of spirit specimens of North American humming-birds ever donated to the institution by one individual. It naturally seems to me that the further Mr. Ridgway goes into this subject the greater is the display of his ignorance of the literature of it. Now when I charge a writer with being ignorant of the literature of a subject I take the pains, as I have done above, to point out wherein his ignorance lies, and do not resort to the remarkable method adopted by Mr. Ridgway—thus, and alluding in his reply to myself, he continues: "Apparently he is not familiar with the literature of the subject, for, if he were posted, he would know that leading authorities on avian comparative anatomy are overwhelmingly if not unanimously against his side of the question." Rather remarkable logic—especially to be immediately followed up in the very next sentence by, "I would therefore suggest that he consult Fürbringer, Parker, Garrod and Gadow, and thus learn regarding the matter which he handles with so much assurance. Even a careful perusal of Huxley (whom, by some strange hallucination, he imagines his abettor), may also prove instructive to him (p. 1040)." To this I would simply reply that in so far as Professor Fürbringer is concerned, I can say that, thanks to his generosity, I am the fortunate possessor, not only of many of his works upon comparative avian anatomy, but also his two massive and superb volumes so familiar to us all, and while I can thank him for his numerous and courteous references to my memoirs in that great work, I must dissent from his views in the matter of the taxonomy, of the Cypseli and Trochili. Apparently Professor Fürbringer had not seen my Linnean memoir, which was defended for me by Professor Parker before the London Linnean Society a number of years ago. There is a reason for that, however, as both works appeared early in 1888.[4]

[4]Shufeldt, R. W., Studies of the Macrochires, morphological and otherwise, with the view of indicating their relationships and defining their several positions in the System. Linn. Soc. Jour.—Zool., Vol. xx, pp. 299–394, Pls. xvii–xxiv (Communicated by W. K. Parker, F. R. S., F. L. S., 19th Jan., 1888). When I spoke of my extensive dissections this was the work I had reference to, and not to the brief note in *Forest and Stream*, as Mr. Ridgway seems to think. It stands to-day as the most extensive paper on the *entire structure* of the Humming-birds ever published by a single individual.

As for Professor Parker, I can say that I had the honor of being one of his constant correspondents for a number of years, and I have from him *several hundred* letters. A year or so before his lamented death it was his intention to supplement my work upon the "Macrochires," and I had sent him some material to that end. I have letters to show from him that he practically agreed with me in the taxonomy of the swifts, swallows and humming-birds, and he proposed to figure one of the latter "as big as a Cochin-China cock!" It is to the loss of the science of systematic ornithology that he never lived to accomplish it. Next as to Garrod. My library contains a copy of his "Collected Scientific Papers," a work I have had occasion to refer to almost daily since its appearance. He was disposed to classify birds upon altogether too few characters; there is no evidence whatever in his work that he ever critically compared the *entire structure* of a humming-bird with that of a swift; he notes simply the fact that "the tensor patagii brevis (in the Cypselidæ and Trochilidæ) and the pterylosis are characteristic, as is the sternum," but he failed to point out how widely they differed morphologically (p. 222). I dissent altogether from his views not only upon his taxonomy of the Cypseli and Trochili, but also from much else that he has left us upon the classification of birds. I must ask Mr. Ridgway for the title of any work from the pen of Professor Gadow wherein I may find a critical comparison of the *entire structure* of a swift and a humming-bird. I know of none, though I *do* know, as do many others interested in the classification of birds, that at the present time Dr. Gadow is hard at work upon probably what will prove one of the best *practical* schemes for the taxonomy of the class, and it will shortly appear. He has already done me the great honor in inviting me to submit my own views to him on the subject, and in a valuable letter I have just received from that able taxonomer I find that he is prepared to admit that the goatsuckers no longer should be retained in the same group with the forms they have usually been associated with heretofore, and he says, "I shall reconsider the position of the Caprimulgidæ and elevate them perhaps on account of Steatornis as Caprimulgi, thus making the difference from Cypselidæ and Trochilidæ more marked, although I shall not go so far as Fürbringer has done." Mr. William Brewster, of Cambridge, the distinguished American ornithologist, and one of the Committee responsible for the "Check-List" of the American Ornithologist's Union, and the classification therein set forth, having read my contribution to *The Ibis* (January, 1893) on Swifts and Humming-birds, writes me under date of February 13, 1893: "It

is comforting to find that there are now, among scientific men of distinction, champions of the belief of my boyhood days that a swift is merely a peculiar kind of swallow."

Now as to my "strange hallucination" in the matter of Professor Huxley's views upon the classification of the Swifts, Swallows, and Humming-birds. I have a well-worn copy of his famous P. Z. S. memoir of 1867—one of the most remarkable contributions ever written upon the classification of birds—and, I may add, a *perfect monumental beacon*, warning comparative avian anatomists for all time in their attempts to classify birds, against trusting to any single set of characters. In his "Cypselomorphæ" Huxley placed only the Swifts, Humming-birds and Goatsuckers (pp. 468, 469). It was done upon only too few characters, and mainly based upon the osteological ones seen at the base of the skull. But Huxley believed the vomer of a Humming-bird was "truncated at the anterior end," an error which both Parker and myself independently pointed out for him. But a quarter of a century is a long time in comparative anatomy (1867-1892), and if Professor Huxley has kept up with the literature of the subject he may hold entirely different views at the present writing. This would appear to be the more probable, as his misgivings were sufficiently strong as to have him write in his 1867 memoir that "In their cranial characters the Swifts are far more closely allied with the Swallows than with any of the Desmognathous birds, the Swift presenting but a very slight modification of the true Passerine type exhibited by the Swallow (*loc. cit.* p. 456). May I ask Mr. Ridgway what he thinks Professor Huxley meant when he wrote that sentence? And does he believe that to-day Professor Huxley would retain the Caprimulgi with the Humming-birds and Swifts together in one group and consider it to be a natural one?

One word more and I have done for the present. In the case of doubtful affinity among birds, as with all other forms, there is but one true way of getting at a solution, and that is to critically weigh and compare *everything* that is known about the one group with *everything* that is known about the other, before finally deciding. Now I challenge Mr. Ridgway to take any species of North American Humming-bird and any species of North American Swift, and arrange in two columns in a comparative way all that is known about either species, paleontologically, biologically, morphologically, or otherwise, and then upon summing up give any real reason why the Trochili and the Cypseli should be considered to constitute by themselves a natural group of birds. I have very serious doubts as to his ability to do this. If he

ever undertake such a task, he must bear one thing well in mind, and that he must not do not do it with the view of "exploding" any one's "peculiar notions," but rather with the view of getting at the truth of the matter. Then, too, do not condemn another's views simply because "leading authorities on avian anatomy are overwhelmingly if not unanimously against his side of the question (p. 1040)." That has been the case with a great many anatomists in the world's history, and even I can remember when the "leading authorities" overwhelmingly if not unanimously believed that *Chamæa* was a *Wren;* but the present writer in his published account[5] based upon his "extensive dissections" claimed it was most nearly related to the Bush-Tits (of the genus *Psaltriparus*), to which opinion the "leading authorities," who have reviewed my work, are now rapidly coming. But no doubt Mr. Ridgway remembers something of this; he most assuredly does if he is familiar with the literature we have upon the subject.

R. W. Shufeldt.

Animal Coloration.[6]—This volume has grown out of materials collected by Mr. Beddard for the Davis lectures delivered at the Zoological Garden of London in 1890. It contains the latest information as to the phenomena of coloration exhibited by animals, together with the most important theories upon the subject, including those of Dr. Eisig and M. Stolzmann, which had not previously found their way into works of a popular character. Mr. Beddard groups his facts under the following heads: Coloration Affected by Environment; Protective Coloration; Warning Coloration; Protective Mimicry; Sexual Coloration.

In summarizing the facts concerning Protective Mimicry, the author concludes that the theory of Natural Selection alone does not satisfactorily explain the remarkable resemblances included under that caption.

The chapter on Sexual Coloration calls attention to some objections to Darwin's theory of sexual selection, and gives briefly a sketch of the views of Mr. Stolzmann and those of Mr. Wallace.

Mr. Beddard's objections to the use to which the theory of Natural Selection has been put by various naturalists, and especially by Messrs

[5] "On the Position of Chamæa in the System." The Jour. of Morph., Vol. iii, No. 3, pp. 475–502, figs. 1–8.

[6] Animal Coloration, an Account of the Principal Facts and Theories Relating to the Colors and Markings of Animals, by Frank E. Beddard, M. A. Oxon., F. R. S. E., with four colored plates and wood cuts in the text. London, Swan, Sonnenschein & Co.; New York, Macmillan & Co., 1892.

Wallace and Poulton, are well taken. While he is far from denying the efficacy of that process, he does not trace to it the origin of characters, and he presents various instances where the latter seem to have been the consequence of the direct action of physical causes. His investigations are especially valuable because they cover a field which has been especially cultivated by the advocates of the exclusive efficiency of natural selection, and he thus throws new light on the class of facts where the evidence for natural selection is strongest. For this reason the work will well repay perusal, as it serves as a corrective to thought which has, in the opinion of many, gone to an extreme in one direction.

FIG. 1. The Stoat in winter pelage, or Ermine.

The author cites the following remarkable example of the direct effect of physical causes in producing changes of coloration:

"That the yellow color of canaries can be altered to an orange red by mixing cayenne pepper with their food has been known for a long time. This curious fact was first discovered in England, as was also the fact that the different races of canaries vary in their susceptibility to the action of the pepper; some kinds are more, others are less affected, while one race is absolutely without any power of having its coloration altered by these means. The color change is produced by feeding the newly hatched young with the pepper conveyed in their food or the old birds while sitting upon the nest are furnished with food containing the cayenne, which they in turn feed their offspring. The color change can, in fact, be only brought about in very young

birds whose feathers are not completely matured; it is quite impossible to produce any alteration upon the full grown canary. Clearly, therefore, here is an instance of the direct effect of food upon color. An interesting paper upon the subject, which has also furnished me with the facts already mentioned,[2] and it will be of interest to give some account of the author's (Dr. Sauermann's) experiments for reasons that will appear. Cayenne pepper, of course, is a composite substance, from which a number of distinct chemical substances can be extracted; the red color is caused by a pigment termed capsicin, which can be separated from the pepper; and it might easily be supposed that the change from yellow to red in the feathers of the canary was simply caused by a transference of the pigment, as in the cases mentioned on p. 127; but Dr. Sauermann shows that it is not so. Yellow colored canaries were not in the very slightest degree affected by the pigment alone; but, curiously enough, parti-colored birds did react—the brown parts of the feathers became distinctly lighter in hue. It is a fatty substance (triolein) which appears to convey the pigment and produce thus a changing of the color from yellow to red; and further experiments were made with other birds, showing that it is not only canaries which are influenced by their food in this way. Some white fowls, belonging to a special breed, showed traces of yellow among the feathers after feeding with cayenne; but in this case these were not racial, but individual differences in susceptibility, for all the specimens of birds experimented with did not react to the stimulus.

"A similar series of experiments was made with some other colors; it was found with carmine that the yellow color was destroyed and the birds became white. This unexpected effect is explained by the fact that a mixture of violet and yellow produces white. The fact that the fatty constituent, triolein, plays the chief part in the coloring of the feathers may perhaps help to explain the very singular fact that the Amazon parrots change from green to yellow when fed upon the fat of certain fishes.

"With regard to the white fowls referred to, the experiments made by Dr. Sauermann were particularly interesting. The interest lies in the fact that the pigment was not absorbed equally by all the feathers; only special tracts were affected; the breast feathers, for instance, became red, while the head remained white. It is therefore quite credible that in a state of nature partial alteration of color may be produced by a change of diet."

[2]Archiv. Anatomie und Physiol., 1889. Physiol., Abtheil., 543.

In a chapter relating to protective resemblances will be found an account of several examples of animals which have apparently acquired a resemblance to their surroundings by the transference of pigment to their bodies in their food.

The list of illustrations comprises four very attractive colored plates and thirty-six wood cuts, each of which repay study.

We reproduce three of these; one that represents color harmony

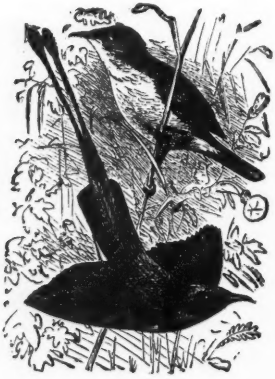


FIG. 2.

The Polytmus humming bird; lower figure the male; the upper the female.

FIG. 3.

The male argus pheasant.

with the environment in the winter pelage of the stoats; and two showing similar feather developments in the tails of the Polytmus humming bird and of the Argus pheasant, in America and Asia respectively.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Currents of the North Atlantic.—Prince Albert, of Monaco, has recently published a chart of the currents of the North Atlantic, entirely based upon the results of a series of experiments he has been conducting since 1885. In that year he launched 160 floats at intervals, along a line of 170 miles, in the direction of N. 14° W. from a point 110 miles northwest from Cowo, one of the Azores. The following year 510 floats were launched, nearly in the meridian 17° 40′ west of Greenwich, between 42° 34′ and 50° N. latitude. In 1887, 931 floats were launched along a line extending from the Azores to the Grand Banks, of Newfoundland. During the same year, a group of floats was launched between two other points in the North Atlantic, between the Azores and Newfoundland.

Of the floats thus launched, 227 were sent back to the experimenter with detailed information as to the place and date of finding. These several histories gave indications of the direction and speed of the currents which floated them. The internal edge of the great vortex performs a revolution with a very short radius round a point south-west of the Azores, and not very distant from them. The cycle described by objects drawn into the vortex is renewed indefinitely, except in the case where they escape by an offshoot into the Arctic regions.

The mean velocity for the region comprised between the Azores, Ireland, and Norway is 3.97 nautical miles in 24 hours; between the Azores, France, Portugal, and the Canaries it is 5.18 nautical miles in 24 hours. From the Canaries to the West Indies, the Bahamas, and even to Bermuda, it attains 10.11 nautical miles in 24 hours. In the eastern portion of the arc, which extends from Bermuda to the Azores, it falls again to 6.42 nautical miles in 24 hours. The mean velocity is 4.48 nautical miles in 24 hours. (Proceeds. Roy. Geog. Soc., Sept., 1892.)

Fins of Palæaspis Americana.—Mr. Claypole has recently published the description of certain objects which he believes to be the fins of *Palæaspis americana*. This fossil Mr. Claypole at first supposed to be a spine, but upon examination it was found to be mar-

gined with a flat fringe around the pointed end and the rounded conical parts were filled with matrix; this central spine-like portion is covered with a layer of the same tissue as that of which the shield is composed; the fringe around the conical central portion is distinctly striate in a direction approximately parallel to its axis. These points of resemblance to a Crossopterygian fin, together with the fact that one of the specimens was found so close to the side of the dorsal shield as to irresistibly suggest a connection, have decided Mr. Claypole to add the character of a fin to his amended definition of *Palæaspis americana*. (Quart. Journ. Geol. Sur. 1892.)

New Reptiles from the Elgin Sandstone.—We have already noticed the reptilian remains from the Elgin Sandstone, which are in the condition of hollow moulds, the bones themselves having entirely disappeared. Casts of these moulds have been made of gutta-percha, which upon examination prove to be models of eight distinct skeletons, of seven species of remarkable reptiles new to science, Professor E. T. Newton, to whom the casts were sent for identification, refers 5 of them to the genus *Gordonia*; *G. traquairi* (2), *G. huxleyana*, *G. duffiana* and *G. juddiana*. In *Gordonia*, as in *Dicynodon*, the maxilla is directed downward and forward to end in a small tusk. The former is distinguished from the latter by the presence of two post-temporal fossæ on each side of the occiput, by the small size of the maxillary tusk, and by the slight ossification of the vertebral centra. A second generic form, *Geikia elginensis* is nearly allied to *Lystrosaurus* Cope, but is distinguished by its shorter muzzle and the entire absence of teeth. The maxilla is produced into a tooth-like prominence, which occupies a similar position to the tusks of *Gordonia*. For the remaining species, Mr. Newton proposes the name *Elginia mirabilis*. The exterior of the skull is covered in by bony plates, the only apertures being the pair of nostrils, the orbits, and the pineal fossa. Horns and spines, varying from ¼ inch to 3 inches in length are found upon nearly every bone of the exterior. This feature reminds one of the living lizards *Moloch* and *Phrynosoma*. With the exception of a smaller number of teeth, the dentition is a repetition on a large scale of *Iguana*. This peculiar skull seems to show affinities with both Stegocephali and Lacertilians, and is unlike any living or fossil form; its nearest, though distant ally apparently being the *Pariasaurus* from the Karoo beds of South Africa. (Nature, Dec., 1892.)

Fossil Reptiles from the Parana.—In the Boletin of the Academia Nacional de Ciencias of Cordova (Argentina), Mr. Juan B.

Ambrosetti describes three new species of fossil reptiles from the Oligocene of the Parana. He also describes more fully three other species already named by Bravard, Burmeister, and Scalabrini. The entire number are referred to five genera, of which four are reported to be new. The descriptions of species are quite full, but the new genera are not described at all, so that they have, so far, no scientific standing. One of them is said to be near to Tupinambis ("Podinema"), and the others are crocodiles. Three of them are regarded as near to the gavials, and are an interesting addition to the South American fauna, if this statement is confirmed. But the author is not yet fully competent for the task he has undertaken. He writes of the "Ameividæ," meaning Teidæ, and imagines that Rhamphostoma was proposed by Burmeister in the Annals of the Museum of Buenos Ayres! His knowledge of classic composition is indicated by his construction of the abortion Oxysdonsaurus, of which an American grammar school boy would not have been guilty. He should have written Oxyodontosaurus, a very awkward name at best. As the genus is not defined, however, nobody is under obligation to adopt it.—E. D. C.

On the Systematic Position of the genus Protogonodon.—The collection of fossil mammalia in the American Museum from the Puerco formation contains among the numerous specimens a few upper teeth, and a number of lower jaws belonging to the genus *Protogonodon*, Scott[1] (= *Mioclænus* Cope, in part). I consider the material referable to the genus *Protogonodon* as the most important in this collection, as it enables me to probably settle the question as to its phylogentic position in the system.

Professor Cope's type of *Protogonodon* is a lower jaw with teeth. In his description[2] of this specimen, he considered it as probably closely related to the Condylarthra, but as he was not familiar with the upper molars, he placed it in the rather indefinite genus *Mioclænus*. Later Professor Scott[3] in his valuable paper on the Creodonta removed the *M. pentacus* from *Mioclænus*, and established the genus *Protogonodon* for its reception. Professor Scott places this genus among the Condylarthra, and probably in the family *Phenacodontidæ*.

The series of upper molars in the collection which I refer to Protogonodon were not found associated with lower teeth, so that their reference to this genus is not absolutely certain. However, as the lower

[1]Proc. Philad. Academy, 1892, p. 322.

[2]Synopsis of the Vertebrate fauna of the Puerco series, 1888.

[3]Op. cit.

true molars of *Protogonodon* are of the sextubercular type, I believe they should be associated with a superior molar which is tritubercular. These upper molars consist of three principal cones with well developed intermediate tubercles; the external cones differ considerably in form from those of the Creodonta (*Sarcothraustes*), but the general form of the upper true molars in *Protogonodon* closely resembles that of the Creodonts.

Another character of the teeth of *Protogonodon* which differentiates it from the Perissodactyle line is the character of the inferior premolars. The last tooth of this series is much simpler in structure than in *Protogonia*, and closely resembles that of *Pantolestes*. It consists of a simple cone with a slightly enlarged heel. In *Protogonia puercensis* on the other hand, a well marked deuterocone is present, and this tooth is nearly as complex as it is in *Phenacodus*.

I believe from these characters of the teeth, and also from the fact that the lower jaw is elongated and slender, as in the genus *Pantolestes*, that *Protogonodon* should be placed near the latter genus, and may stand in ancestral relation to it.

Unfortunately the foot structure of *Protogonodon* is totally unknown, so until that is discovered we cannot decide its affinity with certainty.

It is of great interest to note, if my supposition be correct, that in the genus *Protogonodon* we are dealing with an ancestral Artiodactyle, and that already as far down as the lowermost Eocene (Puerco) the main types of the Ungulata were differentiated. It will not then be necessary to resort as Schlosser has done to derive the Artiodactyla from any of the known Periptychidæ, but that the Perissodactyla were represented by *Protogonia*,[4] the Artiodactyla by at least *Protogonodon* and perhaps other genera, as suggested by Professor Scott. Lastly as Professor Cope has shown the *Amblypoda* were already evolved and represented by the genus *Pantolambda*.

Whether or not these Ungulate stems were in all cases distinct from the Condylarthra, remains for future research to prove; but at least one of them, the Amblypoda, was differentiated. In the case of Protogonodon the structure of its teeth shows that it was fairly well on the Artiodactyle line, but the discovery of its foot structure will demonstrate whether or not it had passed the Condylarthrous stage.

I believe that among the Puerco Condylarthra that *Protogonia* was a persistent type, and nearly all of the Periptychidæ with the possible

[4]Professor Cope informs me by letter that the name *Protogonia* is preoccupied, and he proposes as a substitute the name *Euprotogonia*.

exception of *Mioclænus turgidus* died out and left no descendants.—CHAS. EARLE.

American Museum of Natural History, New York.

The Brown Coal and Lignite of Texas.[5]—Mr. E. T. Dumble's comprehensive report on the fossil fuel supply of Texas has been issued as a separate publication by the Geological Survey of that State. In the course of his investigations, Mr. Dumble found it necessary to visit the mines and factories of Austria and Germany, where by personal observation he ascertained the character, use, and value of lignites, together with the best methods of utilizing this fossil wealth. His report is complete, both from a geological and an economic standpoint. Geologically, he describes the origin, formation, physical and chemical character, and the occurrence of the brown coal. Incidentally a classification of the Texas brown coals is given. As an economist, Mr. Dumble suggests the particular uses to which the varieties of brown coal may be put, discusses the valuable products that may be obtained from it, and gives in detail the most approved methods of making it into artificial fuel by brignetting. In a word, Mr. Dumble has demonstrated that in her brown coals and lignite, Texas has an abundant and cheap fuel supply.

The text is illustrated with a number of cuts of machinery,.and an excellent map.

Extinct Fauna of Mauritius.—At the meeting of the Zoological Society, of London, Nov. 1, 1892, a communication was read from Sir Edward Newton and Dr. Gadow, describing a collection of bones of the dodo and other extinct birds of Mauritius, recovered from the Mare aux Songes in that island by the exertions of Mr. Theodore Sauzier. The collection contained examples of the atlas, metacarpals, prepelvic vertebræ and complete pubic bones of the dodo, which have heretofore been wanting, as well as additional bones of Lophopsittacus, Aphanapteryx and other forms previously known to have inhabited that island. Besides these there were bones of other birds, the existence of which was not before suspected, and these were described as belonging to the genera Strix, Astur, Butorides, Plotus, Sarcidiornis, and Anas.

[5]Report of the Brown Coal and Lignite of Texas. Character, Formation, Occurrence and Fuel Uses. By E. T. Dumble, F. G. S. A., State Geologist.

MINERALOGY AND PETROGRAPHY.[1]

Description of the New Rock Type, Malchite.—The new rock, malchite, referred[2] to a few months ago as the granitic dyke form of diorite, is now described in some detail by its discoverer, Osann.[3] It forms dykes cutting granite in the Odenwald, Germany. In a dense groundmass are rare phenocrysts of dark mica, pale green plagioclase and quartz. The mica is biotite and the plagioclase labradorite. In addition to these the microscope reveals the presence of idiomorphic green hornblende, allanite and sphene. The groundmass in which these lie strongly resembles that of some tinguaites, with hornblende and quartz in place of aegerine and nepheline. It consists of a fine granular aggregate of feldspar and quartz, the latter with occasional idiomorphic contours, and prisms of hornblende imbedded in the aggregate, the prisms often arranged in flowage lines. An analysis of a fresh specimen of the rock yielded:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O	SO_4	P_2O_5	Total
63.18	17.03	.24	6.37	.92	4.17	4.44	2.91	.52	.19	.23	=100.20

The Petrography of Hokkaido, Japan.—In a general geological sketch of Hokkaido, (Jezo or Yesso), Japan, Jimbo[4] declares that the island consists largely of paleozoic beds, probably underlain by amphibolites and various other schists, and cut by granite, diorite, gabbro, peridotite, and serpentine. In the lower portion of the paleozoic the beds consist largely of pyroxenites, with traces of radiolarian remains, phyllites, quartz-schists, limestone, and serpentine. The pyroxenites are aggregates of light colored augite, quartz and feldspar, in which the augite is often more or less changed to epidote and glaucophane. Where the granite cuts the clastics the clay slate is changed by contact action to a biotitic clay slate, to hornfels and to mica schist, with the latter nearest the eruptive. Tourmaline occurs in the schist and cordierite in this rock and in the mica slate. An amphibolite in the contact belt is supposed to be an altered tufa. Schistose granites, diorites and gabbro are phases of the corresponding

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2]AMERICAN NATURALIST, May, 1892, p. 422.

[3]Mitth. Gross. Bad. geol., Landesanst ii, p. 380.

[4]General Geological sketch of Hokkaido, with special reference to the petrography. Satporo, Hokkaido, Japan, 1892.

massive rocks associated with the contact products. Diabases occur as sheets in the unaltered paleozoic beds, and serpentines derived from gabbros and from dunites are met with cutting these at various localities. In addition to paleozoic there are also tertiary rocks on the island, and these are cut by their own systems of dykes and bosses, and are interbedded with characteristic sheets of lava, and layers of tufas. The tertiary volcanic rocks are pyroxene and hornblende andesites, propylites and rhyolites. The pyroxene andesites contain both orthorhombic and monoclinic pyroxenes and occasionally some olivine. They have also a glassy base which sometimes becomes so abundant as to resemble pumice. The hornblende andesite is strongly porphyritic with large phenocrysts of hornblende. The rhyolites are both compact and glassy, in which latter case they are vesicular.

Two Peculiar Rocks from Siberia.—Two very remarkable rocks are described by von Chrustschoff[5] from Taimyr-Land, Siberia. One is an ophitic aggregate of anorthoclase and nosean, containing as accessories sanidine, plagioclase, amphibole, biotite, melanite, magnetite, sphene, zircon and glass. The anorthoclase is in long, narrow crystals of the following composition:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Total
64.59	19.84	2.24	1.26	.63	3.53	7.88	=99.97

Corresponding to Or_2, Ab_6, An_1. The feldspar is usually idiomorphic with respect to the nosean, whose period of formation was between that of the biotite and that of the hornblende. The nosean is in very large quantity. Its density is 2.266 and composition:

SiO_2	Al_2O_3	Fe_2O_3	Na_2O	K_2O	CaO	H_2O	Cl	SO_3	Total
37.83	26.59	.38	22.40	1.63	.54	.87	1.66	8.68	= 99.98

The zircon is of the trachytic type, and is the only accessory of any importance. The author calls the rock taimyrite. The second rock is composed of anorthoclase, sanidine, biotite, and amphibole as essential components, and the other minerals mentioned above in connection with taimyrite as accessories, except that sodalite here replaces nosean. The zircon is of the granitic type, and the rock possesses the granitic texture.

[5]Bull. d. l'Acad. Imp. des Sciences St. Petersb. Mél. Geol. et Paleont., i, p. 153.

An Ottrelite Bearing Conglomerate in Vermont.—It is not uncommon to find ottrelite forming 25% of the schistose groundmass of the conglomerate[6] at the base of the Lower Cambrian, near Rutland, Vermont. The same mineral occurs along shear planes in a blue quartzite and constitutes 40% of a massive bed of the conglomerate. In the last named rock the ottrelite is in rudely circular areas, lying in a dark colored quartz. The areas consist usually of radiating plates of the mineral, disposed in a single plane. Its commonest inclusions are quartz and feldspar, while sericite often forms the centers of the radiating bundles. In the latter case the ottrelite is oriented in parallel position with the mica. Other inclusions within the ottrelite besides those above mentioned are crystals of zircon and rutile, flakes of graphite and plates of ilmenite. In other cases the ottrelite is in plates including large areas of the groundmass of the rock, which is a granulated mixture of quartz and albite (?) in about equal proportions, a large quantity of sericite, and some biotite. In this groundmass associated with rutile are crystals and plates of anatase. No traces of its original clastic structure remain in the rock, though its conglomeratic character is beyond dispute.

Lithophysæ in the Rocche-Rosse.—In parts of the Rocche-Rosse lava stream of Monte Pelato, Lipari, are spherulites with lithophysal characteristics. In some specimens examined by Cole and Butler[7] the spherulitic growth originated about the walls of steam vesicles, and progressed outward into the rock; in other cases they grew inward until they have completely filled the space that was formerly vacant. The importance of the paper lies in the fact that it acknowledges the correctness of many of Idding's views with respect to the formation of lithophysæ, and contradicts the view that regards all hollow lithophysæ as the result of the decomposition of spherulites.

The Composition of the Dune Sands of the Netherlands.—A very elaborate paper by Retgers[8] on the constitution of sand composing the dunes on the west coast of Holland at Sheveningen, near the Hague, contains a large amount of information concerning the character of sands and the method of determining the nature of their constituents. The author carefully fractioned large quantities of the dune sand by the ordinary methods of fractional precipitation in

[6]C. L. Whittle, Amer. Jour. Sci., Oct., 1892, p. 270.
[7]Quart. Jour. Geol. Soc., xlviii, 1892, p. 438.
[8]Recueil des Travaux Chimiques des Pays-Bas., xi, 1892, p. 169.

the usual heavy liquids and by means of the molten substances suggested by himself[9] for this purpose a few years ago, thus obtaining mixtures of mineral grains of about the same density. These then were studied carefully by comparison of their indices of refraction, by immersing them in liquids of known optical densities, until one was found in which the grains became almost invisible. The index of refraction of these is nearly that of the liquid, consequently their nature is thus approximately determined. Microchemical tests and the ease with which cleavage laminæ were produced, served to distinguish accurately between minerals having nearly the same refractive index. The principal minerals identified by the author are orthoclase, quartz, microline, plagioclase, cordierite, calcite, apatite, amphibole, tourmaline, pyroxene, epidote, sphene, sillimanite, olivine, garnet, staurolite, disthene, corundum, spinel, rutile, zircon, magnetite and ilmenite. The surprising discoveries are those of cordierite, calcite and olivine, and of glaucophane among the amphiboles. The proportions of the various minerals present according to specific gravity was 2.5% between 2.5 and 2.6; 85% between 2.6 and 2.7; 7.5% between 2.7 and 3. ; 1.5% between 3 and 3.3; 1% between 3.3 and 3.6; 2.4% between 3.6 and 4.2; .1% between 4.2 and 5.2. The sands are supposed to have come mainly from the rocks of archean terraces.

Quartz-Gabbro in Maryland.—In the Baltimore gabbro area, according to Grant,[10] are quartz gabbros consisting of bytownnite, quartz, hypersthene, secondary hornblende, and a few accessories. The quartz is limpid, and is almost free from inclusions, except for lines of small liquid cavities that traverse the grains, as is usual in granitic quartz. Diallage, which is so common in the normal gabbro of the region, is entirely absent from the quartz-bearing phases, which thus becomes a quartz norite.

Minerals from the Diamond Fields of Brazil.—Hussak[11] describes the characteristics of crystals of brookite, cassiterite and xenotime from the diamond region of Dattas, Minas Geraes, Brazil. On *brookite* from the sands of Diamantina was found the new pyramid, $\frac{1}{2}P\bar{2}$. The *cassiterite* is from Manquinho, near São Paulo. It occurs in a rubellite-bearing lepidolite granite. The *xenotime* accompanies the brookite in the sands of Dattas. On one doubly terminated crys-

[9]Cf., AMER. NATURALIST, 1890, p. 175.

[10]Johns Hopkins Univ. Circ. No. 103.

[11]Min. u. Petrog., Mitth. xii, p. 455.

tal were found the two new pyramids $\frac{4}{5}$P and $\frac{1}{5}$P. The axial ratio of these crystals is 1 : .61775. The author has also made a crystallographic examination of the *monazite* occurring so abundantly in the Brazilian granites and gneisses. The crystals of this substance are always tabular parallel to $\infty P\bar{\infty}$. They contain the same forms as do the Ilmengebirge crystals, but are never twinned. Upon washing a portion of sand from Bohia a 3 mm. long crystal of *euclase* was obtained whose density is 3.1. It is very rich in planes, being possessed of not less than three prisms, six clinodomes and three negative pyramids, beside the clinopinacoid.

Mineralogical Notes.—*Christianite* crystals are reported by Gonnard[12] as lining geode cavities in the basalts of dykes at Queyrières and Fay le Froid, Haute Loire, France. In the latter case the christianite groups enclose many crystals of augite. The trachyte of Montcharet, occurring as a dyke in granite, is cut by fissures whose walls are lined by *chabasite*.[13] The cubic faces of *galena* crystals implanted in druses of quartz at Pontgibaud are roughened by little cavities whose walls have the positions of octahedral planes. The phenomenon is regarded by Gonnard[14] as the result of corrosion. The same author mentions the existence of large crystals of *beryl* in the granites of Droiturier, near La Palisse, Allier, *psilomelane* in mammillary forms at Croix Moraud, Mt. Doré, and cubic pseudomorphs of *quartz* after some unknown mineral, probably fluorite, in the vicinity of d'Aubenas, Ardèche.

Three specimens of *melilite* from Mt. Somma, with densities of 2.917, 2.932 and 2.945 respectively, were powdered, purified, and analyzed by Bodländer[15] with this result:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O	Total
41.34	10.37	4.29	33.84	5.79	1.13	3.45	.08	= 100.29

The author combats the view of Vogt that melilite is an isomorphous mixture of the gehlenite and akermanite molecules. He thinks that the negative variety is an admixture of $R''SiO_3$ and the aluminate R'''_2O_4R'', while the positive variety is a compound of the same silicate with the aluminate $R_2'''O_6R_3''$. Intermediate varieties are isomorphous mixtures of these.

[12]Bull. Soc. Franç d. Min., 1892, xv, p. 28.
[13]Ib., p. 31.
[14]Ib., p. 34.
[15]Neues. Jahrb. f. Min., etc., 1893, i, p. 15.

Moses[16] records the analysis of a granular *nickel arsenide* associated with native silver and siderite in a mine 18 miles west of Silver City, N. Mex. The silver is imbedded in arborescent forms in the brittle gray nickel ore, and this in turn is in a gangue of siderite. The analysis made on impure substance gave:

SiO_2	Pb	Ag	As	Ni	Co	Fe	Total
4.56	tr.	8.38	67.37	11.12	5.13	2.64	= 99.20

Regarding the SiO_2 and Ag as impurities the composition takes a form that may be represented by RAs_3 in which R = $\frac{4}{7}$ Ni $\frac{2}{7}$ Co and $\frac{1}{7}$ Fe, corresponding to a *nickel skutterudite.*

On crystals of topaz from the Province of Omi and from the tin mines of Yenagari Mino, Japan, Matthew[17] finds four pyramids, seven prisms, one of which, $\infty P\frac{11}{4}$, is new, the three pinacoids, three brachydomes and two macrodomes.

Optical Anomalies.—After an exceedingly careful examination of many sections of appophyllite crystals and a comparison of the phenomena they present with those presented by combinations of thin biaxial plates placed one upon the other, Klein[18] concludes that the mineral in its geometrically tetragonal crystals is an intimate mixture of optically positive and optically negative triclinic lamellæ. The positive constituent seems to differ from the negative element in containing no crystal water, since upon heating the positive component appears to increase in quantity. Negative appophyllite becomes positive upon loss of $4\frac{1}{2}$ molecules of crystal water. The investigation is a beautiful piece of accurate optical work.

In a reply to Mallard's[19] remarks on the black garnet pyrenaite Brauns[20] states that the structure described by the first mentioned anthor is exactly what should be expected of a dodecahedral substance under strain, and that the peculiarities of this garnet's optical properties may be easily explained on the Klein-Brauns theory of strain.

Upon soaking in oil sections of zeolites that have been rendered cloudy by loss of water, they again become sufficiently transparent for the study of their optical properties. Rinne[21] has taken advantage of

[16]School of Mines Quart., xiv, No. i, p. 49.
[17]Ib., xiv, No. 1, p. 53.
[18]Neues. Jahrb. f. Min., etc., 1892, II, p. 165.
[19]AMERICAN NATURALIST, Oct., 1892, p. 849.
[20]Neues. Jahrb. f. Min., etc., 1892, I, p. 217.
[21]Ref. Neues. Jahrb. f. Min., etc., 1892, II, p. 237.

this phenomenon and has carefully examined a number of the members of the group with a view to learning something of the changes effected in them by the loss of water. *Natrolite* appears monoclinic under these conditions, *scolecite* orthorhombic, *stilbite* orthorhombic, and each of the other zeolites affords a corresponding meta-zeolite. The optical anomalies often observed in these minerals is thought to be undoubtedly due to partial loss of water.

Isomorphism.—After a long mathematical discussion of the theory of the structure of isomorphous mixtures and upon comparison of the results of investigations upon the optical properties of mixed crystals, Poeckel[22] concludes that we have not yet sufficient data to decide as to whether Mallard's lamellæ theory of the constitution of these bodies is correct or not.

By the use of the method[23] in which colored and colorless crystals of supposed isomorphous substances are allowed to form under the microscope Retgers[24] has proven that the alkaline ferrates are isomorphous with the corresponding sulphates, selenates, molybdates and tungstates, that the potassium tellurates and osmiates are isodimorphous, and that the rutheniate of this metal is isomorphous with its uranate.

The arguments for and against the view as to the isomorphism of calcite and dolomite are given respectively by Brauns and Retgers[25] in a recent letter to the Neues, Jahrbuch. The discussion is too involved to warrant an intelligible abstract in these notes.

Etched Figures.—The matrix of the African diamonds is capable of resorbing[26] *diamonds*, producing on their faces irregular, long, and hemispherical hollows, associated with which are little spheres and grains of black carbonaceous substance, supposed to be a compound of iron and carbon.

Hofer[27] describes corrosian forms on the *calcites* of Steierdorf, Banat, and of Rauris and Salzburg, and ascribes the hexoctahedral faces $\frac{3}{5}4O2$ on the *fluorite* of Sarnthal, Tyrol, to corrosive processes.

[22]Neues. Jahrb. f. Min., etc., B. B., viii, 1892, p. 117.

[23]AMERICAN NATURALIST, June, 1892, p. 517.

[24]Zeits. f. Physik. Chem., x, 5, 1892, p. 529.

[25]Neues. Jahrb. f. Min., etc., 1892, II, p. 210.

[26]Ber. deutsch. chem. Ges., 1892, p. 2470.

[27]Min. u. Petrog., Mitth. xii, p. 487.

Microchemical Reactions.—The methods of testing for traces of ammonia under the microscope, and of precipitating metals with H_2S are described in a few words by Streng.[28]

Directions for the detection of the following minerals in small particles are given by Lemberg:[29] *Scapolite, hauyne, sodalite, eudialite, lazurite, sulphur, olivenite, celestite and melilite.*

Miscellaneous.—Under the title "Rapid Qualitative Examination of Mineral Substances," Moses and Wells[30] publish a scheme for the detection of minerals. The blowpipe method is used with the metallic minerals, but in the silicate group a mixture of the dry and wet methods is made use of. From a hasty reading of the scheme it seems to be a practicable and convenient one.

[28]Neues. Jahrb., 1893, I, p. 49.

[29]Zeits. d. deutsch. geol. Ges., 1892, p. 224.

[30]School of Mines Quart., Nov., 1892, p. 25.

ZOOLOGY.

The German Zoological Society.—The annual report of this society for 1892 is out, and contains among others the following papers: The opening address by the President, Professor F. E. Schultze, described the zoological department of the University of Berlin, where the meeting was held, giving also a sketch of its history. Professor H. E. Ziegler spoke upon the embryonal anlage of the blood in the vertebrates. At first the blood is a clear serum in which no corpuscles appear. Later they are present. Various ideas have been advanced as to their origin. Ziegler vigorously discusses the view which assigns them to the entoderm and decides that they are without doubt mesodermal in origin. Dr. L. Plate described the anatomy and affinities of the Onchidiidæ. These forms belong to the Asiatic region, and are amphibious, living equally well in or out of the salt water. To separate the genera the author uses the relative width of the foot and of that suprapedal region to which he gives the name of hyponotum. The group is of great interest from the fact that though usually regarded as Opisthobranchs they must be considered as near the ancestral Pulmonate. Plate, however, thinks that they have crossed the line and are true Pulmonates, but that their Nudibranch characters are such as cannot be explained except upon the hypothesis of descent from that group. Dr. Thiele, in discussing the phylogeny of the byssus apparatus of the Lamellibranchs, thinks that it must be traced back to some such type as the adhesive glands of Haliotis, and does not agree with Pelseneer in regarding the byssal glands of the Nuculidæ as the most primitive. The fact that either in young or in adult the byssus occurs in most Acephals, is proof to Thiele that the gland must be traced back to the ancestral mollusc. Von Nathusius discussed the form and color of the hair as a basis of classification of the Equidæ. Dr. Korschelt presented a paper on the differentiation of the germ-layers in the Cephalopods with especial reference to the formation of the alimentary canal and the nervous system. According to Bobretzky both the midgut and the nervous system are of mesodermal origin, while several other authors think that the whole alimentary canal is formed by ectodermal inpushings (stomo- and proctodeum). Korschelt finds[1] that at an early date an epithelial layer arises just above the yolk in the anal region. It is distinctly separated

[1]The full paper with illustrations appears in the Leuckart Festschrift.

from the ectoderm by the mesoderm. Later it becomes elevated from the yolk, forming a small cavity open to the yolk, the future mesenteron. This layer is regarded by Korschelt as entoderm, and has been regarded by several authors as the proctodeal inpushing. He also finds the nervous system to be, as might have been expected, ectodermal. Dr. Burckhardt described the central nervous system of the Dipnoi. He has subjected the brain to sections, and by study of these has been able to elucidate points not before understood. He concludes that in its brain Protopterus is not an Amphibian, but that it is in this respect a problematic organism between the fishes (Elasmobranchs) and Amphibia, whose exact position will first be solved when the ontogeny is studied. Professor R. Hertwig had a review of recent work upon canjugation and fertilization, and Dr. H. H. Field a paper on the Metamerism of the Kidney of Amphiuma, already noticed in our pages. The last paper was a view of the idea of instinct, by Professor H. E. Ziegler.

Eyes of Polychætes.—Dr. E. A. Andrews has an extended article[2] on this subject. He has studied a large series of genera, some both as young and adult, and among the conclusions at which he arrives are the following: The eye is an epidermal organ consisting of a pigmented cup containing a refracting mass, which at the orifice of the cup comes in contact with the cuticle. The wall of the cup consists of a single layer of cells forming the retina, each retinal element containing pigment, and being produced internally into a nerve process, externally into a clear rod. This, as will be seen, is a different conception of the annelid eye from either that of Carrière or that of Graber, but one which approaches most nearly to that of the former author.

Arachnida.—Mr. B. I. Pocock discusses[3] the external anatomy of the members of the group Arachnida (*s. s.*), and concludes that the members must be arranged in two sub-classes, Ctenophora, with the single order Scorpiones, and Lipoctena, containing the superorders Caulogastra (Pedipalpi and Araneæ) Mycetophora (Solifugæ), and Holostomata (Pseudoscorpiones, Opiliones, Acari).

F. Purcell, after studying the anatomy and development of the eyes of *Liobunum hemisphæricum*, concludes[4] that contrary to the com-

[2]Jour. Morph., vii, 169, 1892.

[3]Ann. and Mag. Nat. Hist., VI, xi, p. 1, 1893.

[4]Zool. Anz., xv, 1892.

monly accepted ideas, these organs in the Phalangids are to be regarded as compound, and further that they are inverse eyes homologous with the anterior middle eyes of spiders and the middle eyes of the scorpions.

The Fishes of the Pacific Coast of America North of Cerros Islands.—An important paper recently published is an enumeration of the fishes occurring on the Pacific coast of America north of Cerros Island, and to a depth of 150 fathoms by C. H. and R. S. Eigenmann. The authors have placed the dividing line between the littoral and the bathybial faunas of this region at 150 fathoms, because all of the genera so far recorded from this depth have representatives in the shallower water. The few littoral genera which have representatives in deeper water are added as footnotes. Cerros Island is a natural boundary to this region, since south of it few of the characteristic genera of this region are found. The author's observations show that the old division, at Point Conception, of the northern and southern California fauna is incorrect, and that, in reality, no definite boundaries can be assigned for a northern and southern fauna.

The California fauna is distinct from that of Alaska, although four of the species found at San Diego are found in Alaska. The California Fauna is characterized by the abundance of species of Sebastodes, of Cottidæ, and of Embiotocidæ. The last are entirely absent from Alaska, and only a few species of Sebastodes are found there. The boundary between these two regions lies somewhere between Sitka and Puget Sound.

The relative number of species at the principal localities is as follows:

	Species.
The whole of Alaska	108
Puget Sound	107
San Francisco	156
Monterey	148
Santa Barbara	117
San Pedro	82
San Diego, including Cortes Banks	168

There are known from the entire region 382 species, belonging to 228 genera. Of these 116 genera, or more than half, are also found in the Atlantic Ocean, and 32 species are found both in the Atlantic and in the Pacific.

The genera having species in both oceans practically all belong to one of three classes: 1st, Tropical genera; 2d, Arctic genera; 3d, Pelagic and other genera (Ann. N. Y. Acad. Sci., vi, 1892).

On the Mechanical Genesis of the Scales of Fishes.—Mr. J. A. Ryder has advanced a theory that the genesis and arrangement of the scales of fishes is due to the movements of the fishes in swimming. The scales originate in a continuous subepidermal matrix which may be regarded as a basement membrane. Such a matrix is found to actually exist in some forms at an early stage, just beneath the epidermis; in other forms it exists in the larval stages, and in the young of many types of fishes it is coextensive with the whole epidermal layer just at the time when the scales are forming.

In the Clupeoids and Cyprinoids it is found that the myocommata, or sheets of connective tissue intervening between successive somites are attached firmly to the deeper layers of the skin. This construction, together with the peculiar arrangement of the muscle plates at the time the scales begin to form, conditions the further growth of the scale matrix. The ordinary movements of the fish in swimming throw the whole integument into definitely circumscribed areolæ, of which the central portions are in a quiescent state, while the margins are wrinkled or folded as a result of the current action of the lateral muscles of the body.

In each of the circumscribed areolæ a scale develops; the continuity of its development with its fellows across the margins of the areola is prevented by the flexures to which the dermis is there subjected.

The author shows that the imbrication as well as the arrangement of the scales is determined by the action of the segmentally arranged muscles of the body.

Special types of squamation, as those of the eel and the sturgeon, confirm the author's views. In cases where the scales are very fine, that is, several oblique rows corresponding to each somite, the principle holds good, since the rows still conform to the lines of tension of the linear attachment of the myocommata to the integuments.

From the hypothesis and the evidence presented, Mr. Ryder draws the following important conclusion:

1. "The scales of fishes bear a segmental relation to the remaining hard and soft parts, and are either repeated consecutively and in oblique rows corresponding to the number of segments, or they may be repeated in rows as multiples of the somites, or segmental reduction may occur, which may affect the arrangement of the scales so as to

reduce the number of rows below the number of somites indicated by the other soft and hard parts.

2. "The peculiar manner of interdigitation of the muscular somites as indicated by the sigmoid outline of the myocommata, as seen from their outer faces, and the oblique direction of the membranes separating the muscular cones, has developed a mode of insertion of the myocommata upon the corium which has thrown the integument into rhombic areolæ during muscular contraction. These areolæ are in line in three directions, and the folds separating them, particularly at their posterior borders, are inflected in such a manner by muscular tensions, due to the arrangement of muscular cones, as to induce the condition of imbrication so characteristic of the squamation of many fishes."—(Proceeds. Phila. Acad., Part II, 1892.)

The Systematic Position of the Kiwi.—In a paper on the History of the Kiwi, Professor T. Jeffery Parker gives the following conclusion as to the systematic position of this species:

"On the whole it will be seen that the study of the development of the kiwi tends to lessen the gulf between it and ordinary birds, and to show that its ancestors probably possessed many of the more important and distinctive features which characterize the Carinatæ of to-day. The facts clearly indicate that the founder of the Apterygian house had interrupted plumage, functional wings, an ordinary avian tail, a keeled sternum, a double-headed quadrate, lateral optic lobes, and a pecten in the eye; in other words, that the ancestors of the genus were typical flying birds and not bird-like reptiles.

"Of the eight characters enumerated above as separating the Ratitæ from the Carinatæ it will be noticed that the first five are directly connected with the power of flight. We should expect to find such adaptive characters in purely cursorial birds whether they arose from a common stock or sprang separately from early flying birds, and as a matter of fact they occur to a greater or less extent in such flightless birds as the Dodo, Weka, Notornis, etc., which we know have no genetic connection with one another, but have independently acquired the characteristics of flightlessness. I think, therefore, that the possession of the characters referred to by the whole of the Ratitæ is no argument for their common origin.

"The peculiarity of the quadrate has been shown to be a secondary matter, and we have left only the characters of the base of the skull. These certainly form an excellent diagnostic character by which the whole of the Ratitæ are separated from the majority of the Carinatæ,

but even here the distinction is not absolute, for the Tinamous approach in many respects more nearly to the Ratitæ than to the rest of the Carinatæ. Still it seems probable that the various genera of Ratitæ must have diverged from the main line of descent at a comparatively early period, though perhaps not earlier than some of the existing orders of Carinatæ. The Penguins, for instance, are far more reptilian in their vertebral column and less typical in the structure of their wings than the Ratitæ. The Ostrich, however, shows the unique and very reptilian character of two claws on the wing, and the very general presence of wing-claws in the group is a distinctly primitive character.

"Leaving the skull, in which the whole group shows primitive characters, and the wing and related parts, in which the resemblances between the genera are largely adaptive, we find the range of variation in the Ratitæ to be very great indeed. Two genera (Apteryx and Dinornis) have a normal four-toed foot; in three others (Cassowary, Emu and Rhea) the hind toe or hallux has disappeared; while in another (Ostrich) only two toes are left. The pelvis of the kiwi and moa is of the simplest avian type, both pubis and ischia being free; in the cassowary and emu the ischium unites with the ilium; in the rhea the ischiæ unite with one another above the intestines—a unique arrangement; in the ostrich the pubes unite to form a symphysis as in most of the higher vertebrates. The feathers have an aftershaft in the emu, cassowary, and moa, none in the ostrich, rhea, or kiwi. In no order of carinate birds do we find such a wide range of variation as this, and when we add to the characters enumerated the extraordinarily aberrant skull and the structure of the egg shell of the Apteryx, the total atrophy of the wings in Dinornis, and even of the shoulder-girdle in some species of the genus, and the striking differences between the sterna, the shoulder-girdle and the wings of the various genera, we are forced to the conclusion that the existing or lately extinct cursorial birds now known to us are divisible into five well-marked orders, each the equivalent of an entire order of Carinatæ. Of these one order contains the ostrich alone, another the rheas, a third the emu and the cassowaries, a fourth the moas, and a fifth the kiwis.

"As to the relation of the kiwi to the other genera it has been shown to be most nearly allied, as far as its skeleton is concerned, to the moa, differing from it, however, in many important respects. It must certainly have been isolated at a very distant period, and as far as we can see, some of its more striking peculiarities are distinctly correlated to its method of feeding. Most nocturnal animals have large eyes suited

for taking the utmost advantage of the semi-darkness, but the kiwi, finding its prey by scent alone, has developed an extraordinarily perfect olfactory sense, while at the same time, having no need to keep watch against beasts of prey, its eyes have diminished in size and efficiency to a degree elsewhere unknown in the bird class."—(New Zealand Jour. Sci., March, 1891.)

Mammals from the Galapagos Islands.—The mammals collected by Dr. Baur on the Salisbury Expedition to the Galapagos Islands were sent to Mr. J. A. Allen for identification. The collection numbers 12 specimens, representing 4 species, of which 2 prove to be introduced species of *Mus*. The other species are both new, one a bat, *Atalapha brachyotis*, the other a mouse, *Oryzomys baurii*, closely related to *O. galapagœnsis*. The only other species of mammals thus far reported from the Galapagos Islands are two species of Eared Seals, *Otaria jubata* (Forst.) and *Arctocephalus australis* (Zimm.), which were obtained by the Hassler Expedition. The list of known indigenous species thus numbers only five.—(Bull. Am. Mus. Nat. Hist., Vol. iv.)

EMBRYOLOGY.[1]

Echinoderm Eggs.—Karl Fiedler[2] endeavored to corroborate the work of Roux by experiments made at Naples upon the eggs of three species of sea urchin. At first the method used was that of Roux, piercing the egg with a needle. It was found necessary, however, to use a lancet shaped needle made by hammering out and sharpening the tip of a common needle. Later the method of shaking employed by the Hertwigs and by Boveri was, for the first time, adopted in separating the cleavage cells.

The use of the needle under the microscope was attended with a great many difficulties, increased by the large mortality amongst the few individuals that could be successfully operated upon. After the egg membrane is quickly cut the cells may be individually punctured and destroyed. Such embryos can be kept only in large vessels with algæ.

By this means it was possible to pierce a cell so that some of the contents ran out without destroying its power of cleaving, providing the nucleus remained; but in other cases where the nucleus escaped, even with but little protoplasm, the cell died. In the cases where cleavage continued the diminished cell gave rise to small progeny; thus in the four cell stage two cells were much smaller than the others; in the sixteen cell stage two of the four polar micromeres were plainly smaller than the others; in the blastula one half was less convex than the other; but later the difference seems to have been equalized.

When cells are separated by shaking, the remaining ones may change their shape, becoming more spherical where no longer in contact with other cells, but they retain their normal position much as if the other cells had not been removed. Thus when one of the first two cleavage cells was destroyed there resulted an eight celled stage that was half the normal sixteen celled stage, having half the normal number, four, of micromeres at one pole and the other cells likewise arranged as if the sixteen celled stage had been cut into two. The same was true of the half-twenty-eight cell stage. Such half embryos can be formed either by destruction of one of the first two cells or by destruction of two of the first four. The same result is produced by destroying any two of the first four cells, whether they are sister cells or first cousins.

[1] This department is edited by E. A. Andrews, Johns Hopkins University.

[2] Entwicklungsmechanische Studien. Festschrift für Nägeli, Zurich, 1891.

The first four cells are thus all alike in their possibilities as well as in appearance; not so the first eight cells, though they all look alike. When the eight cells are separated into groups of four these give rise to quite different sets, some with eight large, others six large and two little cells, others four large and four small cells. Thus the development of the eight cell stage is largely a process of "self differentiation" of these cells and not due to the mere interaction of the cells of the group.

By destroying one of the first two cleavage cells half-blastulas even, perhaps, half-gastrulas were reared in a few cases from the single remaining cleavage cell. The half-blastulas were obtained both after piercing and removing one cell and by killing it by shaking, which left it still inside the intact membrane.

The half-blastulas showed a tendency to close in as spheres, but died first.

One interesting case suggesting Roux's "postgeneration" was seen, but lost. It consisted of a half blastula lying against a second solid hemisphere covered over by a layer of cells continuous with the half-blastula.

Electricity and Cleavage.—Wilhelm Roux,[3] seeking to determine if electrical phenomena are involved in the process of karyokinetic cell division, subjected frogs' eggs to the action of a current from three Bunsen cells. In these experiments, made in 1885[4], the eggs were placed in a glass tube surrounded by the coiled wire conveying the current.

The result was negative. In the present paper the author describes the results obtained by the use of an alternating current of 100 volts or less, used for lighting the Anatomical Institute at Innsbruck. Here again, the result as far as any connection of cleavage or cell division and the electric current is concerned, was entirely negative. When the current was not strong enough to kill the eggs they divided in the glass tube without any reference to the presence and direction of the current. The same is found to be true of the maximum continuous as well as of the alternating current.

The alternating current is also found to have no directive effect upon the entering sperm or the fusing pronuclei, factors which Roux regards as determining the first cleavage plane. The electric current has, however, a marked effect upon the egg, visible as a change in color at

[3] Bresl. ärzt. Zeitschrift, 1885, No. 6.

[4] Sitzb. Akad. Wiss. Wien., Jan., 1892.

each pole as contrasted with the equator, where such a contraction takes place that at first one might regard the equatorial belt as a cleavage furrow. These changes involve the death of the egg, and are merely a "morphological" polarization produced by the passing current and localized by its direction irrespective of any axial or polar differentiation within the egg itself.

However interesting and valuable the long series of experiments recorded in the two hundred pages of this memoir may be to the physicist and to the biologist, they have for the embryologist of the present day too little direct bearing to make it worth while reviewing them at length.

It should be mentioned, however, that the most diverse objects, frogs' eggs, gall bladders, embryos, hearts, hydras, tritons, lizard and fish embryos, chick and mammal embryos, as well as inorganic substances, such as mercury, copper, lead, etc., exhibit visible differentiation of polar and equatorial areas dependent upon the direction of passing currents. Yet this is not true of even all organic bodies experimented with.

Membranes of the Sea Urchin Egg.—Curt Herbst[5] repeated the experiment of the Hertwigs, and used in addition to chloroform, clove oil, creosote, xylol, toluol and benzole.

Eggs of the sea urchin shaken in water that had been mixed with small quantities of any one of these substances form an artificial egg-membrane just like that normally formed after the entrance of a sperm in fertilization.

This membrane, the author holds, is made by the hardening of the preexistent hyalin outer layer of the egg.

The subsequent separation of the membrane from the surface of the egg is probably due to the secretion of some jelly-like substance. The egg does not shrink away from the membrane at all.

The sperm has no direct part in the formation of the membrane, but merely acts as a stimulus to the egg. If the membrane is removed from a fertilized egg (by shaking) the presence of more sperms does not cause the formation of a new membrane. If, however, some of the above substances are used, a second membrane is formed. Two membranes, one inside the other, may be formed from eggs having one membrane, or even from those having the first membrane removed. The cause of this membrane formation is to be sought for in the egg itself.

[5]Biol. Centralblatt, Jan., 1893.

Experiments on Cleavage.[6]—Dr. Jacques Loeb, of the University of Chicago, has made a most valuable addition to our knowledge of the cleaving ovum. His experiments were simply the exposure of the eggs of sea urchins (*Arbacia*) to water containing more or less than the normal amount of sodium chloride.

The general result is stated as follows: "If we reduce the irritability of the protoplasm of the egg by reducing the amount of water contained in it, the nucleus can segment without segmentation of the protoplasm. If we increase again later the amount of water, and consequently the irritability of such an egg, the protoplasm at once divides into about as many cleavage cells as there are nuclei pre-formed. The segmentation of the protoplasm in the egg, and probably in every cell, is only the effect of a stimulus exercised as a rule by the nuclei."

The following illustration of the character of the experiment is presented by the author: Eggs taken a few minutes after impregnation were divided into four lots, one put into normal sea water, one into that concentrated by adding 2 g. Na Cl per 100 ccm., the other two into sea water concentrated by addition of 1.3 g. NaC and 1 g. Na Cl per 100 ccm. in each case.

When the eggs in normal sea water had arrived at the two celled stage none of the others had as yet begun to cleave. In the least concentrated solution the cleavage soon followed and in the more concentrated solution it followed about an hour later, but in the most concentrated solution no cleavage took place. Concentrations greater than 2 g. per 100 ccm. produced plasmolysis. The form of the cells indicates the amount of water and the intracellular pressure; thus in normal water the first two cells are nearly hemispheres, but in concentrated solutions the cells approach more and more toward a spherical shape.

Other experiments bring out the interesting point that the effect of salt is not to destroy but to suspend the cleavage phenomena. When the eggs are put back into normal water after staying some time, but not as long as twelve hours, in concentrated water, the suspended cleavage begins and goes on much as in a normally situated egg. The longer the eggs have been in the concentrated water the more numerous are the cleavage cells formed all at once when the egg is returned to normal water. An interval of about twenty minutes in the normal water must elapse before the sudden appearance of the retarded cleavage cells occurs.

[6]Journal of Morphology, vii, 1892.

The behavior of the nuclei of the eggs in concentrated sea water was observed somewhat in live eggs and in certain stained eggs which Dr. Conklin prepared for the author. It seems that the nuclei increase in numbers in the salted sea water when there are no cleavage furrows visible on the outside of the egg, but this increase is not always accompanied by a normal separation.

In the light of the conceptions of Fol and O. and R. Hertwig regarding the effects of polyspermy in producing a cleavage into many simultaneously formed cells it might have been urged that Dr. Loeb's results were due to polyspermy.

Granting, however, that the increase in nuclei takes place while the eggs are in the salted sea water such facts as the effect of this water in paralyzing the spermatozoa, as observed by the author, show that the spermatozoa cannot be connected with these peculiar cleavage phenomena.

Regarding the method of action of the salt used in these experiments we must premise that the author in previous work upon hydroids came to the conclusion that growth and regeneration in animals and plants is a function of the amount of water contained in the cells. The application of this to the present case is in the idea that increasing the concentration of the liquid about a cell decreases its irritability by removing water from it; the effect is the same quantitatively and qualitatively as would be produced by lowering the temperature.

The normal source of the stimulus which the abstraction of water is supposed to render no longer efficient to produce cleavage is considered to be the nucleus. The nature of this stimulus is unknown, but some facts lead toward the assumption that it may be a chemical one.

On the other hand the protoplasm has some influence upon the nucleus; possibly the intracellular pressure determining the form of the cell also fixes the direction of the nucleus, which will then be less defined in a mass without cell walls.

ENTOMOLOGY.[1]

Termitophilous Insects.—E. Wasman has lately described[2] a number of new termitophilous insects, erecting for part of them the genus Termitobia and has summarized our present knowledge of the guests of termites. He says that very little is known concerning the guests of the termites as compared with those of ants, largely because the former are chiefly confined to the tropical and sub-tropical regions and also because the investigation of their nests is more difficult. But in spite of this more than fifty species of termitophilous animals are known. Of these forty belong to the Coleoptera, two to Orthoptera, one to Heteroptera, one to Lepidoptera, two or three to Thysanura, one to the mites (Acaroidea), one to the Arachnida, and one is a Nematode. Of the beetles one is a species of Glyptus with its larva, and thirty-nine are Staphylinidæ. The author refers to the investigations of Mr. E. A. Schwarz in North America.[3]

Notes on the Mouth Parts and Thorax of Insects and Chilopods.—The difference between the mouth parts of true insects and Chilopods are usually mentioned in text-books. But when one believes that insects must have come from some form similar to living Chilopods, it becomes a matter of interest to see what is the homology between the various parts of the mouth. As it is usually stated, Chilopods have one pair of mandibles, two pairs of maxillæ, and a pair of maxillipeds; insects a pair of mandibles, one pair of maxillæ, and a labium. The mandibles are of similar structure in both groups. In Chilopods the first pair of maxillæ are two-lobed; the second pair of maxillæ, or first pair of legs (as it is sometimes called), is, in structure, like a pair of legs; the maxillipeds are a modified pair of legs, large and powerful, used for seizing the prey. The dorsal scuta of the segment to which the maxillipeds belong is frequently not wholly united to the head, but is plainly visible (*Lithobius*).

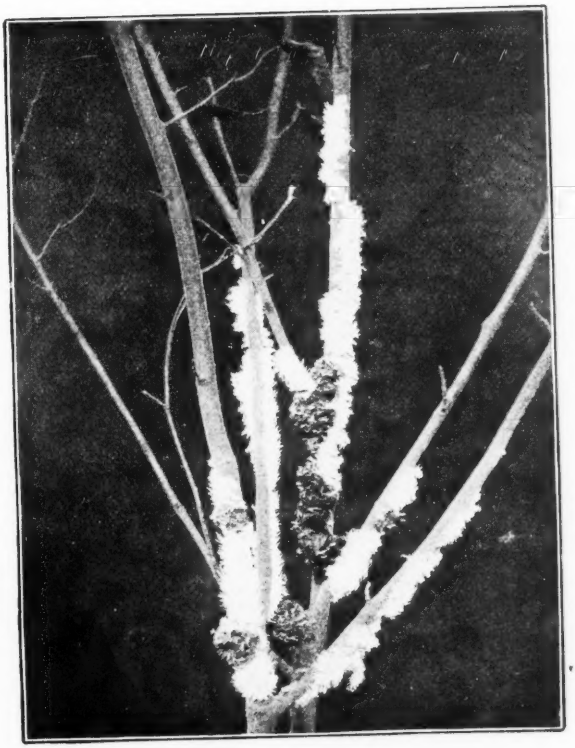
We here see what is well-known among the higher Crustacea; the tendency to the cephalization of thoracic segments in order that their appendages may function as mouth parts. If such is the case, what

[1]Edited by Clarence M. Weed, Hanover, N. H.

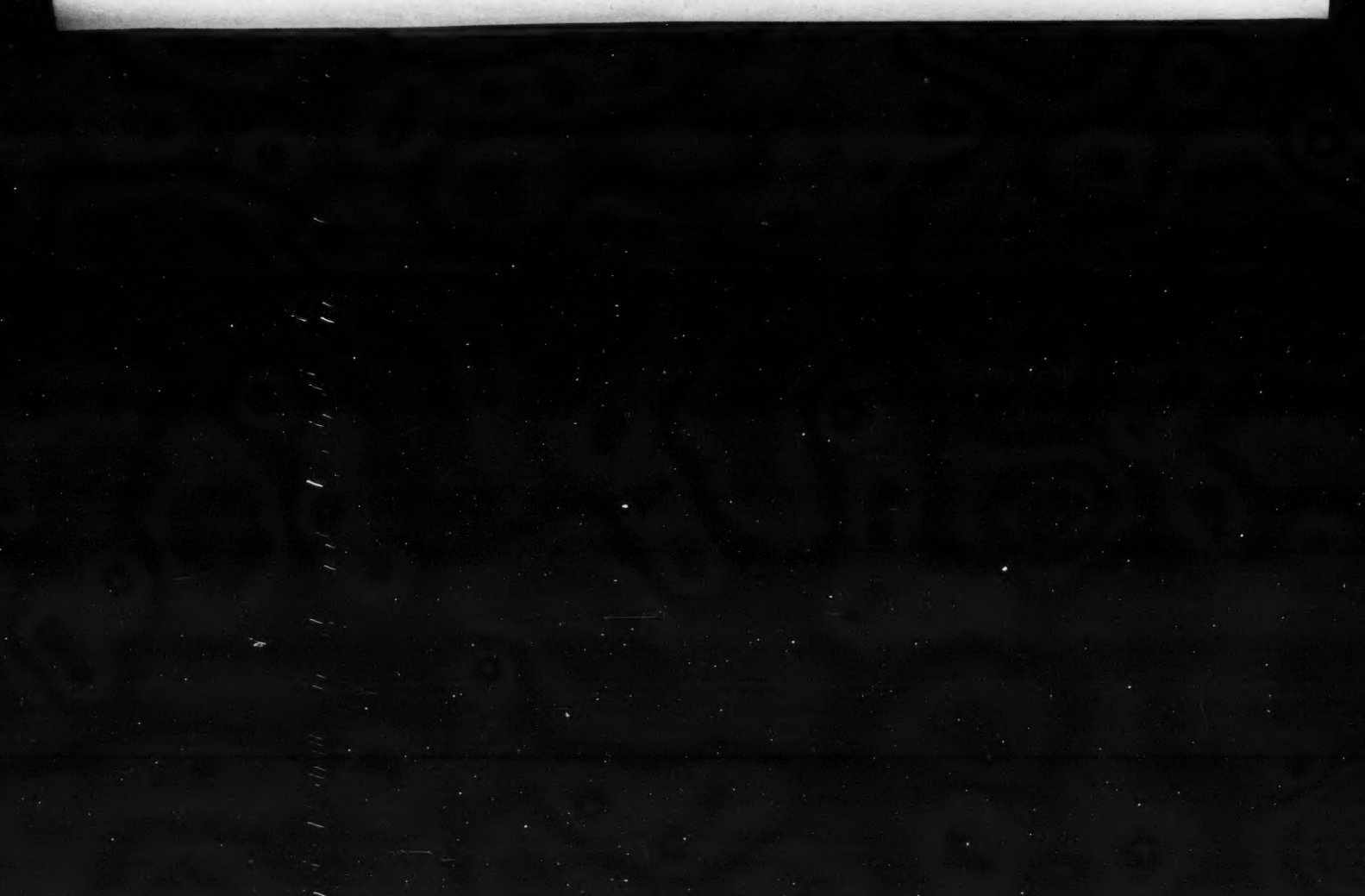
[2]Neues Termitophilen, mit einer Uebersicht über den Termitengäste. Verhandl. Zoologisch botanish Gesellsch. in Wien, xli, 647.

[3]Proc. Ent. Soc. Wash., i, 161.

PLATE X.



The Woolly Alder Aphis.



has become of the second maxillæ and the maxillipeds? The maxilla of insects is composed of three portions, the palpus, the galea, and the lacinia with the basal joints. If now we look at a Perlid larva (the lowest winged insect) the secret lies revealed; the basal joints of the maxillipeds have united to form the sub-mentum, the remaining joints by their pressure have united to the basal joints of the maxillæ. Yet in the Perlid larva the union is not complete and one can plainly see that the palpiger is not articulated to the stipes, but has basal joints which are concealed by the stipes and the two parts of the cardo. So that the maxillæ of insects is equal to the first maxillæ of Chilopods plus the maxillipeds. The labium of insects appears to be the same as the second maxillæ of Chilopods, the mentum being the united basal joints.

I would also call attention to the steady tendency observable in Chilopods toward the union of certain thoracic segments. In the lower Chilopods (Geophilus) the segments are all of about equal size, and each one bears a spiracle. A little higher, in Scolopocryptops, we see that there are two kinds of segments, the large with spiracles, the small without them. Segments 2, 4 and 6 are small, the 7th and 8th both large, after that every other one is small. In Lithobius the process is continued still further, the small being smaller, the large larger. In Scutigera (the highest Chilopod) the dorsal scutæ of the small segments become united to the larger ones, so that seen from above, the first scuta (prothorax) covers one pair of legs, the second scuta (mesothorax) covers two pairs, the third scuta (metathorax) covers two pairs, and the fourth scuta covering three pairs of legs. Therefore I conceive that the mesothorax and metathorax of insects are each composed of two segments. This would appear quite probable if one but look at a grasshopper; but there exists greater proof. Machilis (a common Thysanuran) has on each abdominal segment a pair of small appendages, which have been recognized as representing legs, but the meso- and metathorax also bear these appendages beside the normal legs; hence if these appendages represent legs the meso- and metathorax of Machilis must be compound segments. It is possible that each abdominal segment is compound, but I hardly think this probable, since the first abdominal segment of insects, which is very small, appears to represent the small sixth segment of Scutigera. If this theory of the insect thorax be true, the thorax consists of five segments, segments one, three, and five bearing legs, segments two and four bearing wings.

Nathan Banks, Sea Cliff, N. J.

The Woolly Alder Aphis.—In the current report of the New Hampshire Experiment Station observations are recorded by Clarence M. Weed which show that in autumn large numbers of the young of this species (*Schizoneura tessellata* Fitch) are born by the parthenogenetic females. These young descend the alder shrubs to the surface of the ground, where they congregate, under various sorts of shelter, in enormous numbers. They remain there throughout the winter, and in spring those which have not been washed away or otherwise destroyed climb up the trunk to the limbs, where they fix themselves on the lower surface of the bark and grow rapidly into other parthenogenetic females. No males, females, or eggs have been found. This insect has been very abundant in New England during recent years; the appearance of an infested branch is shown in the accompanying plate.

Further Note on the Tineid Case-worm from the Grand Canyon—In my description of the seed-like lepidopterous case-worm from the Grand Canyon in the February, 1893, number of THE NATURALIST, pp. 166–169, figs. 2 and 3, it should be mentioned that the hair line in fig. 2 shows *twice* the natural size of the larva. Fig. 2 was intended to be reduced one-half, and was so indicated on the margin of the original drawing. The hair line was made twice the length of the larva, so that when the whole was reduced one-half it would represent the natural size, stated in the description as $2\frac{3}{5}$ mm.

It seems very certain that this larva is a tineid. It is well-known that these small larvæ often construct cases in which they live; and, as Dr. Packard states (Guide, p. 342), the larvæ of some of the smaller tineid genera (Antispila, Tinagma, etc.) are absolutely footless.

The narrow-leafed willow referred to in the description is *Salix longifolia* Muhl., while the round-leafed leguminous tree is *Cercis occidentalis* Torr. The elevation of that part of the canyon referred to as 2500 ft. below the rim is 5000 ft. above sea level.

C. H. TYLER TOWNSEND.

The Puparium of Blepharipeza.—*Blepharipeza* is a genus of Tachinidæ s. str., belonging in the subfamily *Hystriciinæ*, and thus closely allied to *Dejeania* and the other Tachinidæ that are characterized by the presence of dense and spiny macrochaetæ on the scutellum and abdomen. *Blepharipeza* may at once be recognized in this group by its hind tibiæ being thickly ciliate on their outer edge with more or less flattened bristles.

The following description is drawn from a puparium of *Blepharipeza adusta* Lev., from which emerged a ♀ specimen of the fly, both of which were sent to me by Mr. Harrison G. Dyar, who bred the fly from a larva of *Halisidota argentata*. It will serve to indicate the distinctive features of the puparium in this interesting genus. I do not know that any description has ever been published of the puparium in this group, except the very brief one of *Belvosia bifasciata* by Dr. Riley (Bull. 3, U. S. Ent. Com., p. 42). The latter indicates the puparium of *Belvosia* to be very different from that of *Blepharipeea* in the structure and situation of the anal stigmata or spiracles. This may serve to emphasize the distinctness of the two genera, which some authors have been prone to combine under the name *Belvosia*.

Description of Puparium.—Length, 10 mm.; greatest width and thickness, 5 mm. Color dark brown. Almost cylindrical, perfectly rounded at both ends, the anterior end a little less in diameter than the posterior, the transverse and dorso-ventral diameters of each segment equal. There appear to be 12 segments, including the capital and anal plates, but the segments are very ill-apparent on the posterior end, very plain anteriorly. A belt or zone of circular (longitudinal to the belt, transverse to the puparium) minute corrugations alternate with one having a rugose surface, there being 10 of the corrugated or fluted belts, and 10 of the rugose or punctured belts. The rugose belts are about one-half the width of the fluted belts, and there is apparently one of each to each segment of the puparium, not including the capital and anal plates. The anterior one-third of each segment is occupied by the rugose belt, and the posterior two-thirds by the fluted belt, these belts more or less clearly defining the segments. Mouth parts of larva showing on capital plate as a wrinkled protuberance consisting of 4 principal eminences, separated from each other by a wrinkle or fold of the integument. Each eminence is more or less minutely wrinkled, the wrinkles as well as the large folds radiating from the center of the protuberance. Anal stigmata showing an anal plate at center of posterior extremity of puparium, as a pair of organs, each marked by 3 short raised ridges, the two upper ones more or less parallel with each other, inclined outward above and at an angle of about 45 degrees with the lower one, which is not quite parallel with the transverse diameter of the puparium. These ridges are usually more or less slightly curved; when curved, it is always with the slight convexity outward from the center of the organ or stigma. The two stigmata occupy the same transverse plane of the puparium. What appears like an anal vent is situated exactly ventrally of the pair of

anal stigmata, forming with them the corners of an equilateral triangle, the vent representing the lower or exactly inferiorly directed angle. This vent consists of a circular raised portion of the integument, rugose in appearance, of about the same diameter as either stigma, and with a little circular pit-like depression on top. Exactly ventrad of this vent is a smaller, more irregularly shaped tubercle, apparently situated on the tenth segment. It is hardly more than three times as much removed from the anal vent as that is from either stigma, measuring from center to center.

The puparium is furnished inside with a fine, white, silken, membranous lining.—C. H. TYLER TOWNSEND, Las Cruçes, New Mexico.

MICROSCOPY.[1]

The Solution of the Dust Problem in Microscopy.—The statement of the dust problem is this: Given a stock of cleaned microslips and cover-glasses, to keep them clean and ready for use at any moment, without the necessity of brushing or wiping them. The following solution is the result of a laboratory study of the problem, and is now announced after having received the approval of leading microscopists.

The objects to be accomplished are:—

1st, To secure a dust-proof magazine for storing the cleaned microslips and cover-glasses in separate compartments for the different sizes of squares, circles, and oblongs.

2d, To provide simple mechanical appliances for removing a single slip or cover without exposing those remaining in the case.

3d, To provide an automatic device for warning the operator of the approaching exhaustion of his stock of any of the shapes of covers and of slips, thus avoiding the necessity of opening the case except to replenish stock.

4th, To provide against the breaking or disarrangement of the covers iu case of the accidental overturning of the case.

5th, Incidentally to provide a mounting table with guides for centering the objects and cover-glasses, the whole apparatus being so constructed that the glasses are not touched by the fingers, and only once by the forceps until the slide is completed and labeled.

The Dust-proof Slip and Cover-glass Case[2] fully meets these requirements.

Plate VI is a front view of the case which is 4½ inches square on the base and 6 inches high. The slips and mounting table are contained in the lower half and the cover-glasses in the upper portion. The mounting table is shown in position for work, and the concentric lines for guidance in properly centering the objects and covers are seen on the celluloid slip. Four dust-excluders are hinged to the front of the grooved table, and two of them are shown opened so as to expose the slots through which the cover-glasses pass out upon the grooved table. The milled head of the roller which pushes the cover-glasses out of the slots is shown at the side of the case. A screw stop is inserted in the front of the case above each slot.

[1]Ed. by C. O. Whitman, University of Chicago.

[2]Patent applied for.

The case is fitted for 3 inch by 1 inch glass slips of any thickness, and has a capacity of six to twelve dozen. It has four compartments for the cover-glasses of the sizes ½ inch, ⅝ inch, ¾ inch, ⅞ inch, or 12mm, to 24mm., either circles or squares or oblongs of the above widths, and any lengths up to 2¾ inches. The screw stops regulate the depth of the slots for either No. 1, 2 or 3 thickness of cover-glasses.

Plate VII is a vertical section from front to back, showing the plan of the case. The section of the lower half is made in the median plane, that of the upper half in the plane of a screw stop. Through the base (b) projects the stop (s) into a narrow groove in the mounting table (mt) which slides in and out between the base and the floor (f) of the stock compartments (sc′). The service compartment (sc) is deepened by a shallow cavity cut into the upper surface of the mounting table, and in the bottom of this cavity is fitted a sheet of celluloid bearing a series of concentric lines. The slips (ss) are stacked in the service compartment, the lowest slip filling the shallow cavity in the mounting table as shown at (ss′). A warning slip of paper (ws) is folded around the front edge of the top slip. The loose partitions (p) running in grooves in the sides of the case can be removed after sliding back the cover (c). In the base (f′) of the cover-glass case is the groove (r′) for the roller (r) which is made of brass and covered with chamois. To the front of the base is hinged the brass dust-excluder (de) whose lining of silk plush protects the grooved table (t) and the slot (sl) from dust. The dust-excluder also prevents the delivery of a cover glass by the roller except when the slot is opened. Into the slot projects the point of the screw-stop (st) which is so adjusted as to permit the passage into the slot and out upon the grooved table of only one cover-glass at a time. Above the roller are stacked the cover-glasses (cg). Near the top of the stack is placed the warning disk (w) and upon the top cover-glass rests the loosely-fitting follower (cf) which prevents displacement and breaking of the covers, if the case is accidentally overturned. The adjustable partition (ap) may be moved backward or forward to fit any length of cover-glass from ½ inch to 2¾ inches. The cover (c′) is so constructed as to exclude dust.

Plate VIII is a front view of a form of the case as made for one size cover-glass, either circles or squares, and of either ⅝in., ¾in., or ⅞in. diameter. The open dust excluder is hinged above the slot at the sides of the case. The engraving does not show the groove in the table in front of the slot. A slip is shown in position in the mounting table. One of the lateral grooves in the mounting table is not represented.

The plan in general, is the same as in the complete form illustrated in Plates VI and VII.

Method of operation.

Thoroughly dust the inside of the case and partly, or completely, fill the compartments with clean slips and cover-glasses of the proper sizes and place the warnings in position. The apparatus is then ready for immediate use, or at any time during successive weeks or months until the stock of slips and covers is exhausted.

The slips are withdrawn from the case singly by pulling forward the mounting table, and from this they are removed, either before or after an object is mounted, by inserting a finger into the notches cut into the sides of the table. The mounting table is automatically reloaded on being pushed back into the case. The warning slip having been withdrawn, the service compartment is again filled by removing the sliding cover which carries with it the cover-glass case, withdrawing a loose partition and sliding the cleaned slips from a stock compartment into the service compartment.

Whenever a cover-glass is needed, the dust-excluder in front of the proper slot is opened by a touch of the finger, the milled wheel is rotated and the chamois covered roller pushes the bottom cover-glass through the slot and out upon the grooved table, where it is readily grasped by the forceps. This action is positive because the friction between chamois and glass is greater than between two clean glass surfaces. The table being grooved, only the extreme margins of the cover-glass touch it. A touch of the finger closes the dust-excluder.

It will be noted (a) that the slips and covers are doubly protected from atmospheric impurities by the dust-proof case and the constant contact of clean glass surfaces with each other; and (b) that in the process of removal for use they do not come in contact with any surface from which they receive dust. They come out as clean as when, weeks or months before, they were put into the case. Thus the dust problem is solved.—A. H. Cole, A. M., University of Chicago.

Cooling Paraffine.—To those who have experienced the inconvenience and difficulty connected with the preparation of good paraffine sections in the Tropics or even in the Tropical Summers of other climates, the following simple device of Professor C. Gracomini[1] may be a welcome suggestion.

[1]Arch. Ital. de Biolegie, IX, 1888, p. 380.

A small rubber tube, a meter or so long is connected with a vessel of ice-water partly stopped at the other end so that a slow stream passes through it. This tube is wrapped around the paraffine block upon the microtome and cools it off so that thin sections can be cut.

If in winter the paraffine is too hard, the same device with warm water may be resorted to.

PLATE VI.

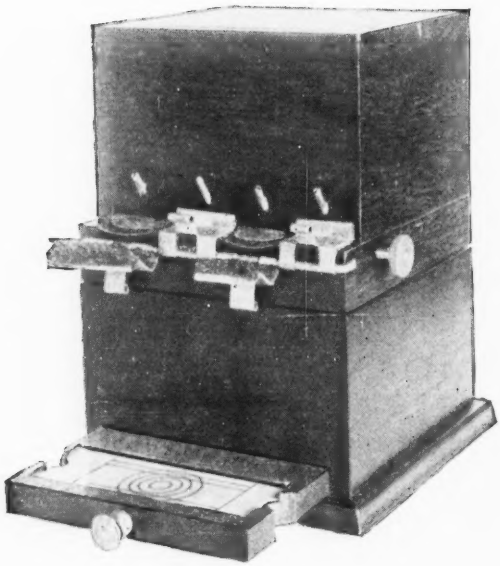
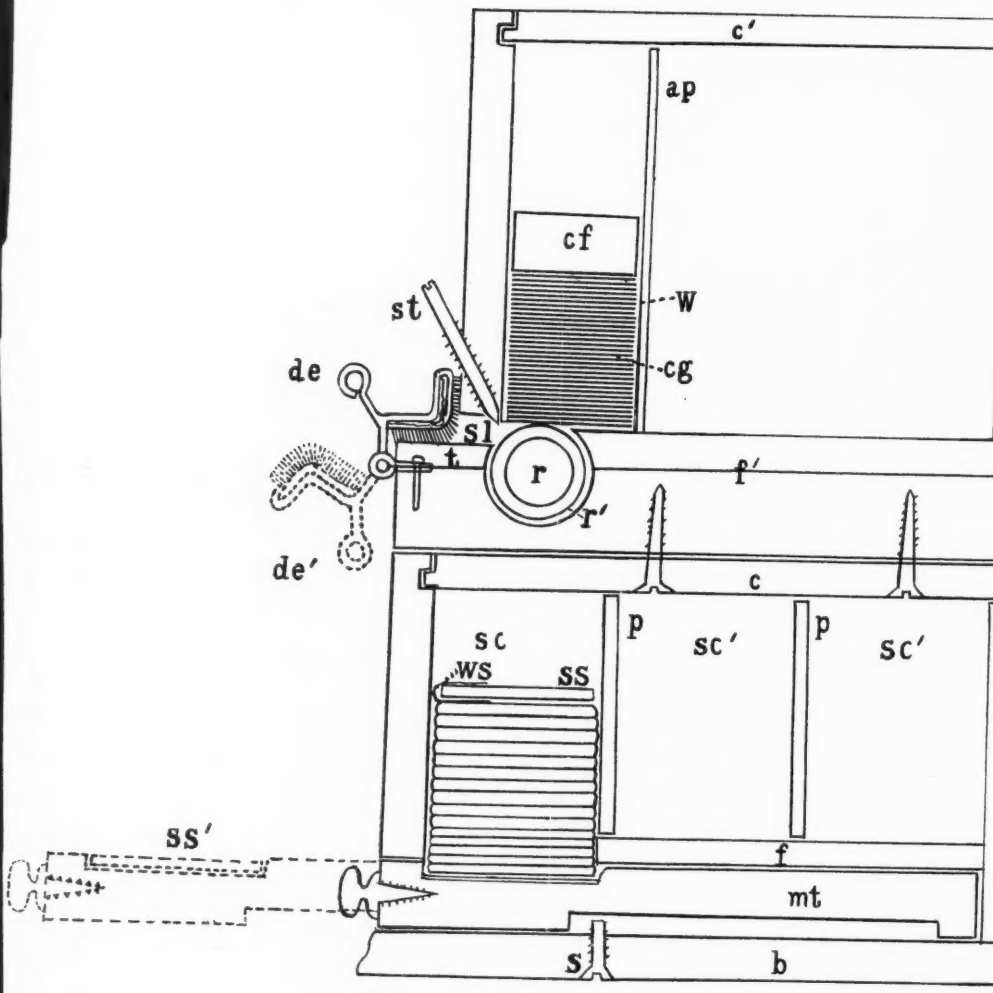


PLATE VII.



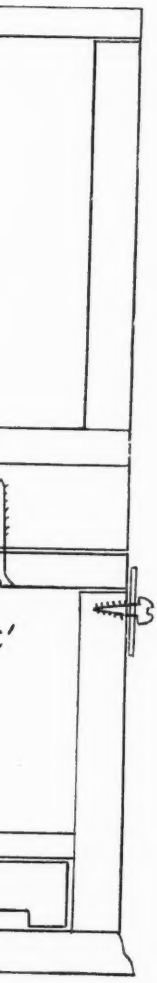
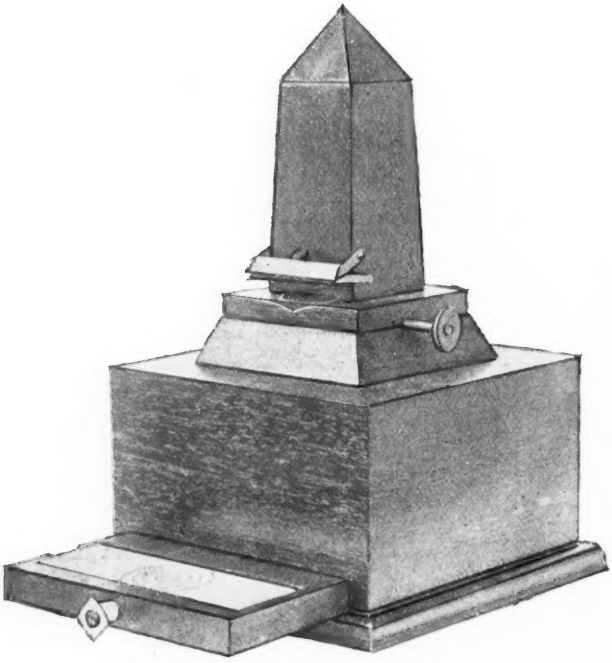


PLATE VIII.



PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History, February 1.—The following papers were read: Mr. H. L. Harris, A new instance of the capture of streams; Professor W. T. Sedgwick, The natural history of disease.

February 15.—The following papers were read: Professor Henry W. Haynes, More evidence of cannibalism among the Indians of New England; Dr. R. T. Jackson, Notes on the development of palms; Dr. S. J. Mixter, A Massachusetts beaver dam.

March 1.—The following papers were read: Prof. E. S. Morse, A curious Aino toy; Dr. C. Willard Hayes and Mr. M. R. Campbell, The structural features (geomorphology) of the southern Appalachians. Maps and diagrams were shown and a discussion followed, Professor Davis, Mr. Upham and others participating.

SAMUEL HENSHAW, *Secretary.*

New York Academy of Sciences, Meeting of Biological Section, Feb. 13, 1893. A paper on the Functions of the Internal Ear was presented by Dr. F. S. Lee, based upon a study of dog-fish. The results of experiments were given showing that the semicircular canals are sensory organs for dynamical (rotational) equilibrium, otolithic parts for statical (resting) equilibrium. Each canal appreciates movement in its own plane and by a definite functional combination of canals all possible rotational movements are radiated. This theory explains compensating movements of eyes, fins and trunk. The method of experiment was that of sectioning the branches of the acoustic nerve and stimulation (by rotational movements) of the living swimming fish.

In a paper by Bashford Dean on the Marine Laboratories of Europe a series of views was shown of the stations of Naples, Banyuls, Roscoff, Plymouth, Arcachon, the Helder, and St. Andrews.

H. F. Osborn described the foot of *Artionyx*, the new member of the order *Ancylopoda* Cope. It is distinguished from *Chalicotherium* by the artiodactyle character of ankle and pes.

BASHFORD DEAN, *Rec. Sec.*

The Biological Society of Washington.—The following communications were made: Mr. M. B. Waite, the Destruction of Lichens on Pear Trees; Mr. C. H. Townsend, The Propagation of the Atlantic Coast Oyster on the Pacific Coast; Mr. Charles Hallock, The Geographical Distribution of the Musk-Ox; Dr. C. Hart Merriam, The Four-toed Kangaroo Rats (with exhibition of specimens).

February 25.—Communications: Mr. Sheldon Jackson, The Introduction of Reindeer in Alaska; Mr. M. B. Waite, Variation in the Fruit of the Pear due to Difference of Pollen; Mr. E. M. Hasbrouck, On the Development of the Appendages of the Cedar Waxwing; Mr. F. A. Lucas, The Food of Humming-birds.

FREDERIC A. LUCAS, *Secretary.*

Anthropological Society of Washington.—Special Meeting, February 14.—The program consisted of a lecture, A Primitive Priesthood, by an Initiate. Illustrated by lantern slides by Frank Hamilton Cushing.—WESTON FLINT, *Secretary.*

SCIENTIFIC NEWS.

Errata in Mrs. Bodington's article "Legends of the Sumiro-Accadians of Chaldea" in THE AMERICAN NATURALIST for February, 1893, p. 105.

Page 105, Line 2 from bottom, for Bohu read Bahu. (N. B. Bohu in the last line is correct.)

Page 106, Line 4; for Herodach read Merodach.

Page 107, Lines 13, 18, 21, 25, 30, and 36; for Tzdubar, read Izdubar.

Page 107, Line 14; for Tshtar read Ishtar.

Page 108, Line 1; for Tzdubar read Izdubar.

Page 108, Lines 12 and 31; for Tshtar read Ishtar.

Page 209, Lines 5, 8, 12, 18, 24, 31 and 37; for Tshtar read Ishtar.

Page 110, Lines 4, 7 and 15; for Tshar read Ishtar.

In the January Number, 1893.

Page 14, Note 1; for Story of the Natives read Story of the Nations.

Dr. Henry Wheatland, of Salem, Mass., died February 27, 1893 aged 81 years. Dr. Wheatland graduated at Harvard in 1834, and

later at Harvard Medical College. While a student at college he received instruction in zoological studies from Nuttall, the ornithologist and botanist. Later he turned to anatomical work and then to the study of marine zoology. Under his instruction the late William Stimpson did his first dredging in Massachusetts Bay. For many years Dr. Wheatland has been President of the Essex Institute at Salem, Mass., and he has been trustee of both the Peabody Academy of Science at Salem, and the Peabody Museum of Archeology and Ethnology at Cambridge since their foundation. In later years his energies have been devoted to the study of local history. Personally, Dr. Wheatland was a delightful companion, and his stories of the older days of American Science were especially interesting.

Mr. A. Smith Woodward, of the British Museum, has gone to the Lebanon to explore the deposit of fossil fishes.

Professor R. Ellsworth Call is now instructor in Physics and Chemistry in the Manual Training High School, Louisville, Ky.

The Tacoma Academy of Sciences is endeavoring to have the name Mt. Tacoma adopted as the official title of what was formerly known as Mt. Ranier. If the Academy could have the name of the State of Washington changed to Tacoma it would be a great convenience. We have too many Washingtons already.

The Leuckart "Festschrift," the volume of the contributions of the former students of the celebrated Leipzig zoologist, brought together at his seventieth birthday, makes a splendid quarto volume illustrated by forty plates. Thirty-five pupils contributed to the memorial.

Richard Greeff, Professor of Zoology in Marburg, died August 30, in his sixty-fifth year.

J. G. Joessel, Professor of Anatomy in the University of Strasburg, died Dec. 4, 1892, in his 55th year.

Professor W. Pfitzner, of Strassburg, has been appointed to the position left vacant by the death of Professor Joessel. His assistants will be Drs. Mechnert and Heinrich Hoyer (of Würzburg).

Professor F. C. Noll, for many years editor of the "Zoologiscenh Garten," died in Frankfurt a. M. Jan. 14, 1892.

Dr. Jan Pieter van Wickevoort Crommelin, an ornithologist, died in Haarlem, Holland, Oct. 20, 1892.

Thomas John Moore, Curator of the Liverpool Museum, died Oct. 31, 1892.

Dr. Benjamin Vetter, Professor of Zoology in the Royal Polytechnicum of Dresden, and well-known as the translator of many works, died in the night between Jan. 1 and 2, 1893.

Professor H. Schaaffhausen, the anthropologist of Bonn, is dead in his 77th year.

Professor James Ellis Humphrey sailed Feb. 11th on a botanical collecting expedition to Jamaica, where he wishes especially to study the algae of the Caribbean Sea.

Mr. Samuel Henshaw is in charge of the entomological collection of the Museum of Comparative Zoology at Harvard.

The University of Minnesota is publishing a "Quarterly Bulletin." From the last issue (Jan. 30, '93) we gain the following: The herbarium of the University and of the State survey are merged together In the past three years 350 species of Minnesota fungi have been determined. In 1892 over 20,000 species of flowering plants were collected in the limits of the State, and the collections now contain about 900 species from the region. In the line of geology considerable work has been done in collecting lower Silurian fossils near the University; while the collections have received many additions from other States. In zoology considerable work is being done. The Museum has been fitted with cases, but the curator reports that the collections still leave much to be desired. Not half the birds of the State are represented, while the collections of fishes, reptiles, amphibia, etc., are largely in prospect. The labors of the zoological survey during the past summer were mostly in the neighborhood of Mille Lac, which was pretty thoroughly explored, and work is being carried on, so that a few years hence there will be one of the best local faunal collections for reference and comparison in the country. The University also proposes to establish a Biological station on the upper Mississippi to be open without fees to all who may wish to come. The location will be decided later. A laboratory for histology and embryology in the College of Medicine has been fitted up with equipment for elementary and advanced work.